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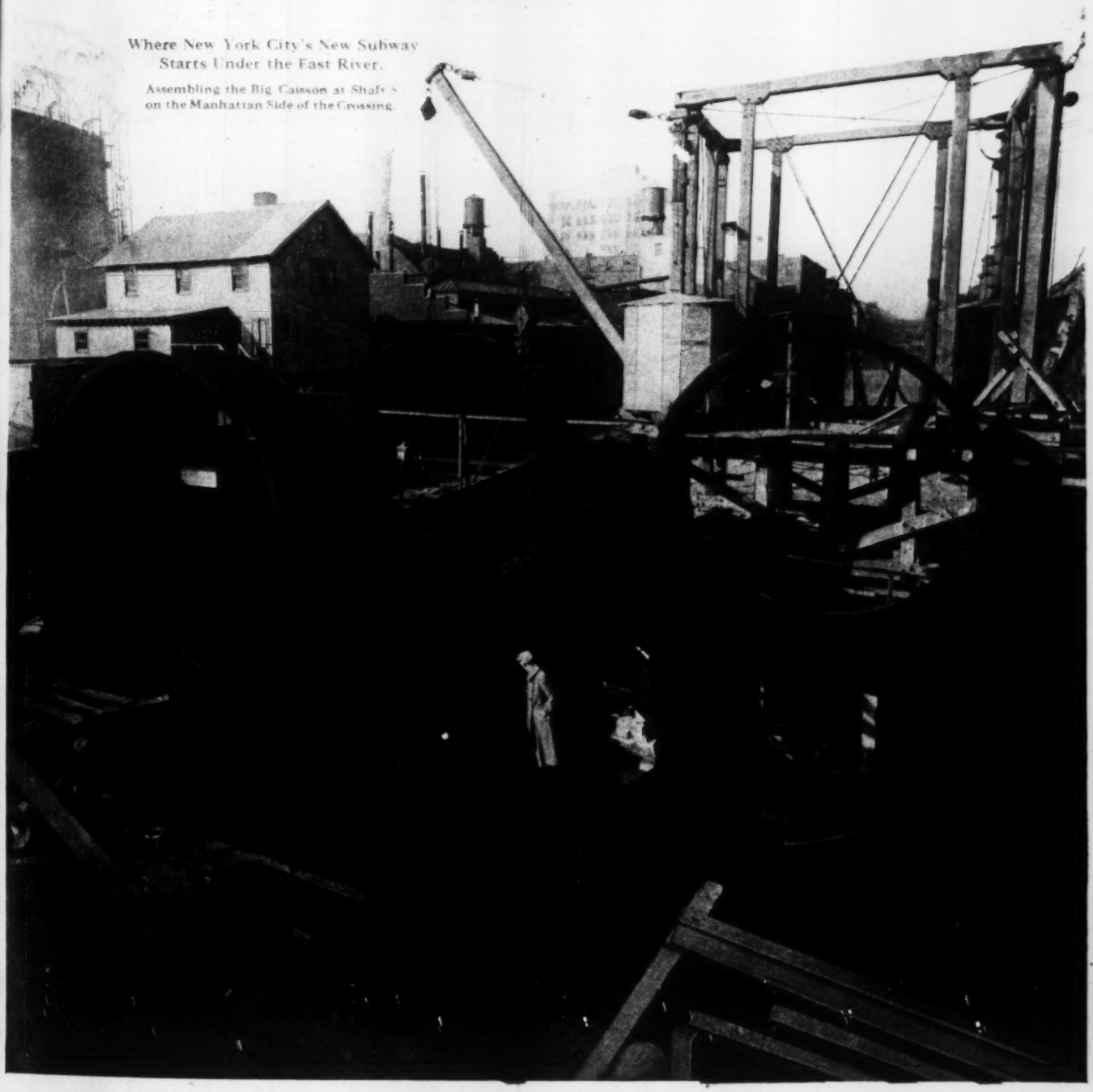
June 7, 1917



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Assembling the Big Caisson at Shaft 5 on the Manhattan Side of the Crossing.

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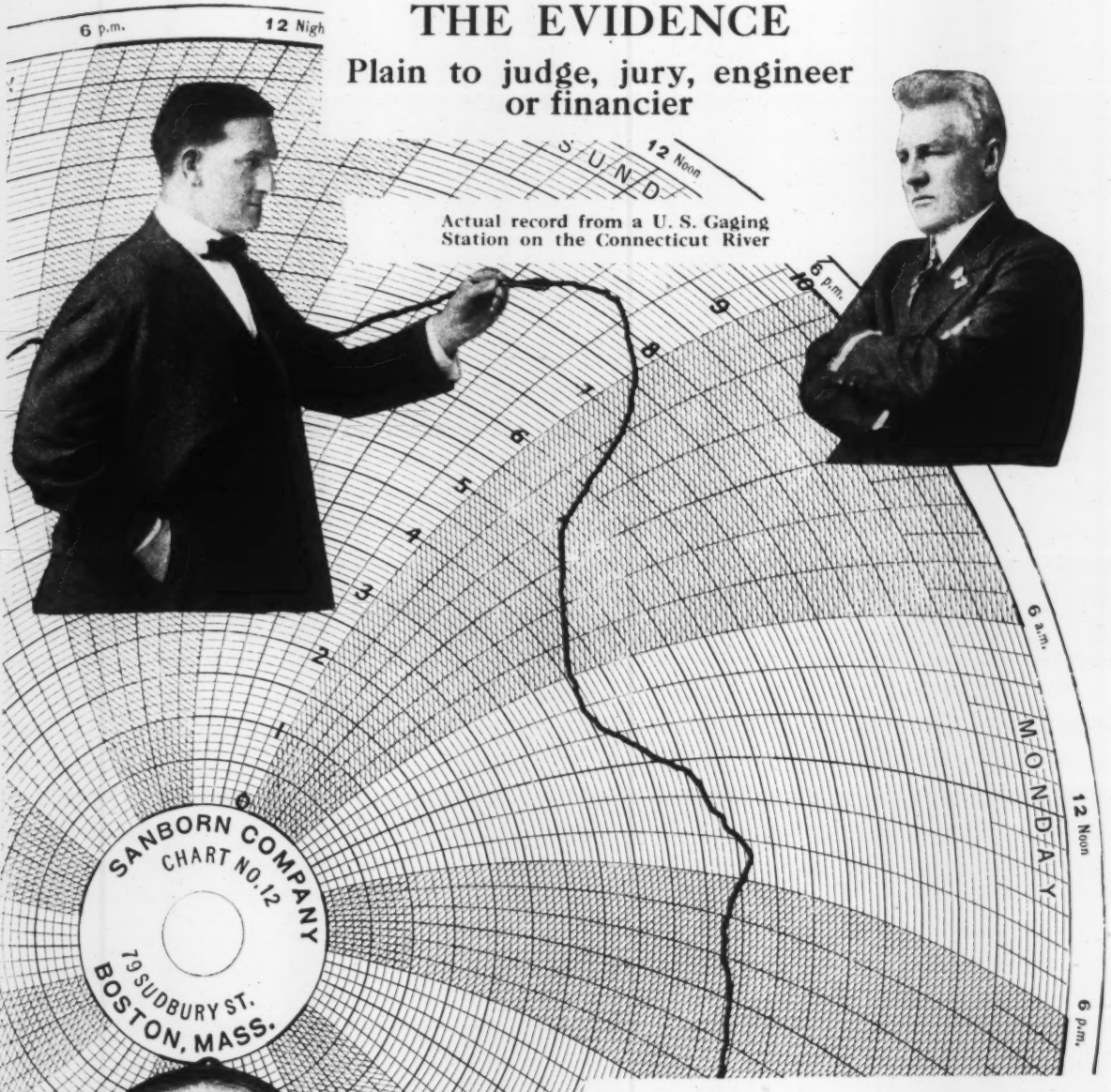

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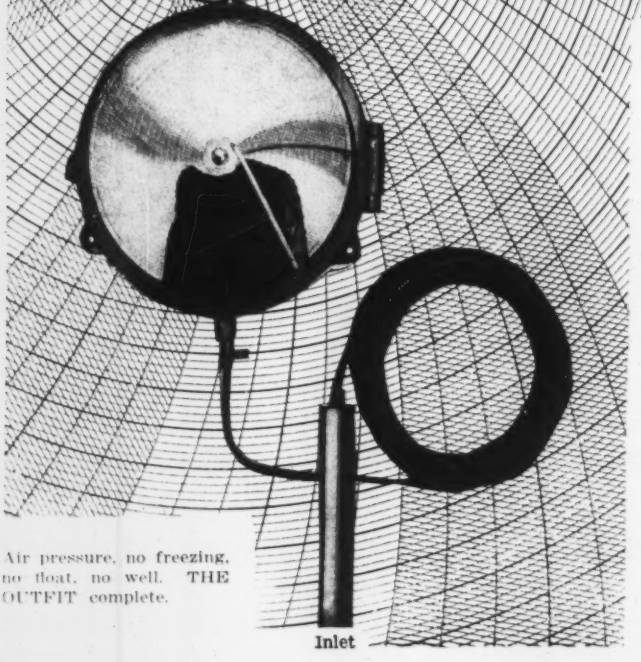

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River Front Improved Without Cost to Taxpayers

Leasing of Filled Land at Davenport Pays Interest on Bonds and Forms Fund for Retiring Them

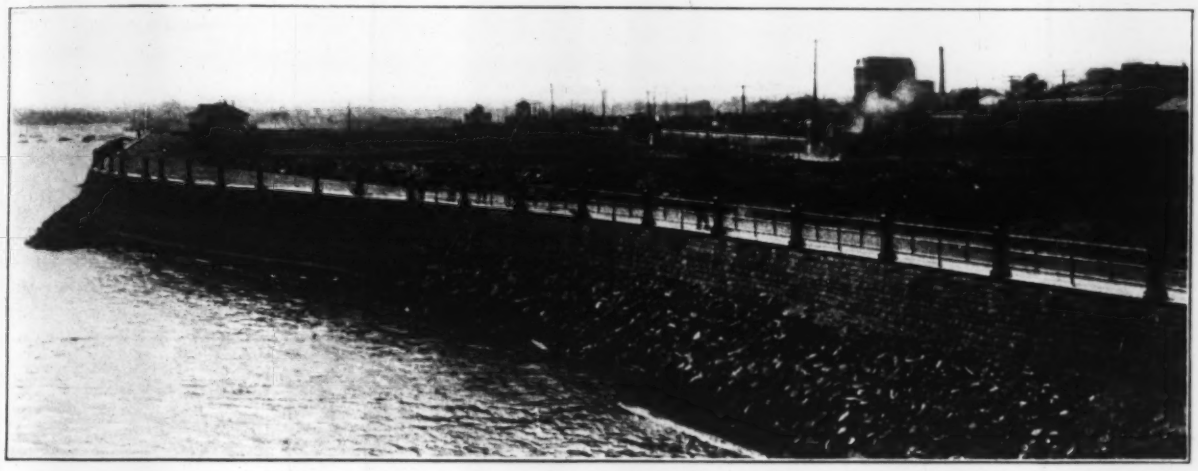


FIG. 1. MUNICIPAL RIVER-FRONT IMPROVEMENT AT DAVENPORT, IOWA

THE use of garbage for filling and the leasing of made-land to provide funds for paying for the improvement are two of the features of the water-front work along the Mississippi River at Davenport, Ia. The city, with a population of 50,000, has its business section on a slope between the river and the high ground or bluffs. Until a few years ago its water-front was in private ownership, occupied by railway tracks and an unattractive industrial district, while the river bank was an unsightly dump, as is so often the case in river towns.

New Harbor Line Established

With the combined idea of civic and industrial improvement, and provision of facilities for river traffic, a project was developed for the rehabilitation of the river front. The first steps were to establish a new harbor line and build a river-front wall and then to fill in the space between this and the old bank. The improvement is in the hands of the Davenport Levee Improvement Commission, and the work thus far completed has about a mile of river front. The earlier stages of the project were described in *Engineering Record* of Apr. 4, 1914. Fig. 1 shows a part of the river and the fill for the park. The general arrangement is shown in Fig. 2.

For about 3000 ft. at the upper end the new land has been assigned for industrial and terminal purposes, and laid out in 100-ft. lots 100 to 175 ft. deep, except that space for a railway yard has been reserved just north of the Government bridge. A masonry wall forms the river front along this site. Next to this comes a paved sloping levee 1000 ft. long, as required by the War Department to provide facilities for steamboats. Below this is a 10-acre public park and playground, with a masonry wall. The surfacing and laying out of this was done by the city's Park Board. A special advantage of this water-front park is that it is easily accessible to the people of the tenement district, while the other parks involve expenditures for car fare.

The park at present marks the lower end of the improvement, but the plans provide for a future extension below it, which will add about two miles of river wall and 140 acres of land to the present work.

Construction and Operation

The river wall, which extends along the front of the industrial district and the city park, is of dry stone masonry, built upon a rubble-stone base whose top is a little below low-water level. It is backed with rubble stone, behind which is the fill of rubbish and sand, deposited as the wall is built up. The purpose of this construction was to avoid trouble from freezing, as the water drains out freely through the wall. It was considered that a concrete wall would be cracked and bulged unless an unusual number of weepholes were provided. The top of the wall is slushed with concrete, and a concrete curb is built along some portions. The levee has a 6-in. concrete base, with large anchor blocks for mooring rings. It is paved with old brick removed from the streets, the joints being thoroughly filled with cement grout. The depth of water along the bulkhead wall is about 8 ft. when the river is at low-water stage. Typical cross-sections are shown in Fig. 3.

One problem was to secure material for filling the space behind the wall. There is no local sand or gravel available, as the river has at this point a bare rock bed. Sand has to be brought by barges and costs about 35c. per yd. Dumping of garbage in the river was prohibited by the War Department in 1911, and a report made by John W. Alvord, of Chicago, recommended disposal by burial. It was decided, therefore, to use the space behind the wall for dumping rubbish and garbage, spreading this in layers and covering it with 2 ft. of sand. It is stated that there has been no objectionable odor except when a heavy storm washed holes in the new sand covering. The sand is unloaded from barges by a locomotive crane with grab-bucket, which delivers it to a stock pile or directly to an elevated bin. This bin has bottom gates for loading dump wagons which drive beneath it.

The sewers are extended through this fill by lines of cast-iron lock-joint culvert pipe, which are embedded in concrete in the river wall. This is shown in Fig. 4. All construction work has been done by the Levee Commission with its own forces, under the direction of Thomas Kelly, Superintendent in Charge of Construction.

The new industrial district is separated from the river by a strip of public land. It has a track on each side, and back of the wall is a crane track, so that locomotive cranes can handle freight between barges, steamers, cars and warehouse platforms. At the north end of the paved levee is a municipal freight house, for the benefit of small shippers, and a conveyor will be installed for the prompt and convenient handling of package freight to and from the boats. All switching within terminal limits

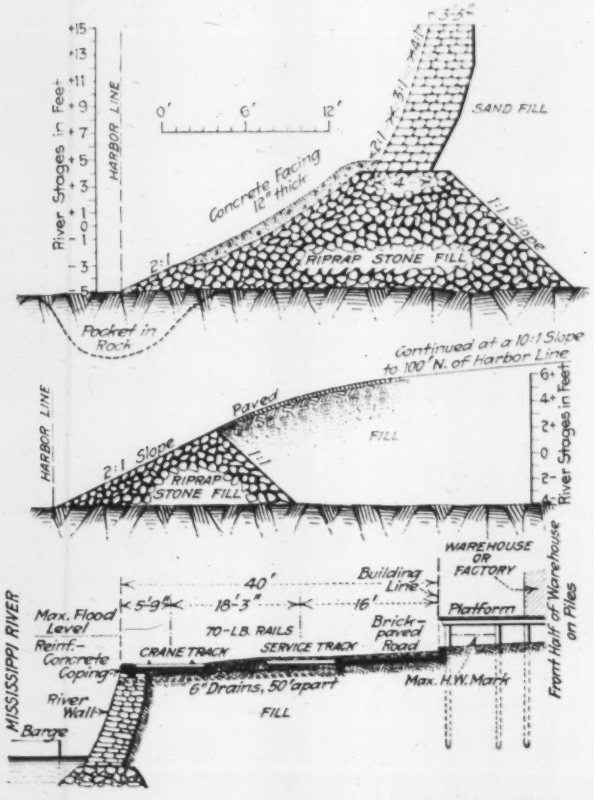


FIG. 3. SECTIONS OF RIVER WALL AND LEVEE

FIG. 4. CITY SEWER EXTENDED ACROSS RECLAIMED LAND TO NEW RIVER-FRONT WALL

and the operation of all freight-handling devices will be under the direction of the Levee Commission.

Railway alterations are included in the plans. The street which runs at the back of the new land (and which was originally on the river bank) has at present several tracks for main-line, yard and switching service. To improve this undesirable condition it is proposed to remove the present team tracks and sidings to a point south of the business section of the city, and to leave only two main tracks and an industrial track. New station facilities will be provided in the rear of the park, as shown in Fig. 1. The new freight station (between Ripley and Scott Sts.) is to be built this year, and the passenger sta-

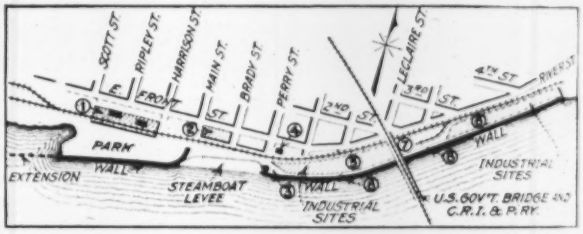


FIG. 2. PLAN OF RIVER-FRONT IMPROVEMENT AT DAVENPORT, IOWA

1—Site for new passenger and freight station. 2—New interurban station. 3—Municipal freight house on levee. 4—Old railway station. 5 and 6—Sites for industrial plants on reclaimed land. 7—Freight yard. 8—Public space along river front

tion (between Harrison and Ripley Sts.) in 1918, while the track depression and all incidental railway changes are to be completed in 1921. These plans have been agreed upon between the city authorities and the railways, which operate jointly over this line.

Financing the Project

The method of financing this extensive improvement is of particular interest, since it involves no expense to the taxpayers. Bonds are issued to provide funds for the construction. The leases of the reclaimed lands furnish a revenue which pays the interest on the bonds and forms a fund for retiring the bonds in 20 to 25 years. As the revenue increases, additional bonds will be issued up to the total required to complete the work. The railways using tracks on the street also pay a larger rental now than the nominal sums paid under the old arrangement.

At present, about a mile of river wall and 1000 ft. of levee have been completed, reclaiming 20 acres of land at a cost of $150,000. This land is valued at $500,000. The complete project includes about three miles of river wall, reclaiming 140 acres of land. The total cost is estimated at $750,000, while the value of the 140 acres is estimated at $2,500,000.

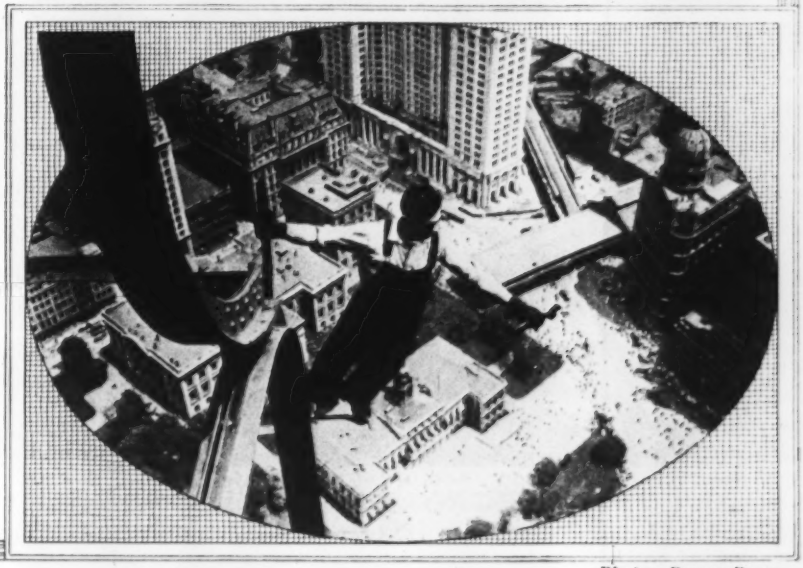
This river-front improvement project and the method of financing it originated largely with W. D. Peterson, who proposed it nearly 20 years ago, and who has served for a number of years on the Davenport Levee Improvement Commission. The design and construction work have been in the hands of A. M. Compton, Chief Engineer (and his predecessor, W. H. Kimball). The new municipal freight house at the levee was designed by R. J. Clausen, architect, who is secretary of the improvement commission.

Accidents on Construction

What They Cost and How to Prevent Them

By J. J. Rosenthal

Safety Engineer, Industrial Accident Commission of California



Photo—Brown Bros.

ALTHOUGH much attention has been devoted to accident prevention on railroads and in manufacturing industries, practically no safety precautions have been enforced on construction work. There seem to be two reasons for this lack of attention: That the work is of a temporary character and that the worker is injured in most cases by falling or being struck by some object falling from above.

From the standpoint of the safety expert, construction work can no longer be classed as a temporary industry. Safety precautions are necessary and are applicable regardless of the duration of the construction period. The worker can be protected in large degree from the danger of falling by the provision of substantial scaffolds, stagings and flooring, at the same time that similar safety measures can afford him sufficient covering to protect him from objects falling from above.

Safety Laws To Govern Construction

California is pioneering in the enforcement of safety regulations in the construction field. Three years ago, with the advent of the Workmen's Compensation Insurance and Safety Act, it was required that all places of employment indoors or outdoors, above or below ground, should be made safe. The Department of Safety of the Industrial Accident Commission has engaged in a vigorous campaign to carry out the provisions of this act, and an organization has been developed for the inspection of construction work and the investigation of accidents that occur during its progress.

An analysis of accidents in connection with this work has led to the compilation of the accompanying accident table, covering all classes of construction work. The table shows a considerable reduction in the number of accidents in 1915 and an increase in 1916. This is because 1914 and 1916 were marked by greater construction activity than the intervening year. Comparing the figures for 1914 and 1916, however, shows the actual reduction of accidents which can be attributed to rigid inspection and the adoption of methods for safeguarding the worker.

TABLE SHOWING INJURIES SUSTAINED ON CONSTRUCTION WORK IN CALIFORNIA

Class of Accident	Fatal			Serious			Slight		
(See note below)	1914	1915	1916	1914	1915	1916	1914	1915	1916
A	50	34	40	19	16	15	1,635	1,652	1,678
B	72	47	60	166	146	161	3,415	2,225	2,769
C	17	13	12	11	16	15	5,359	6,988	6,040
D	14	12	13	29	23	26	91	164	141
E	12	12	11	13	9	11	763	987	904
Totals	165	118	136	238	210	228	11,263	12,016	11,532
Grand totals		419			676			23,279	

Note—Class of accident is as below:

A: Injuries resulting from the lack of shoring and bracing of tunnels, trenches, excavations or sheeting or sheet piling of treacherous ground.

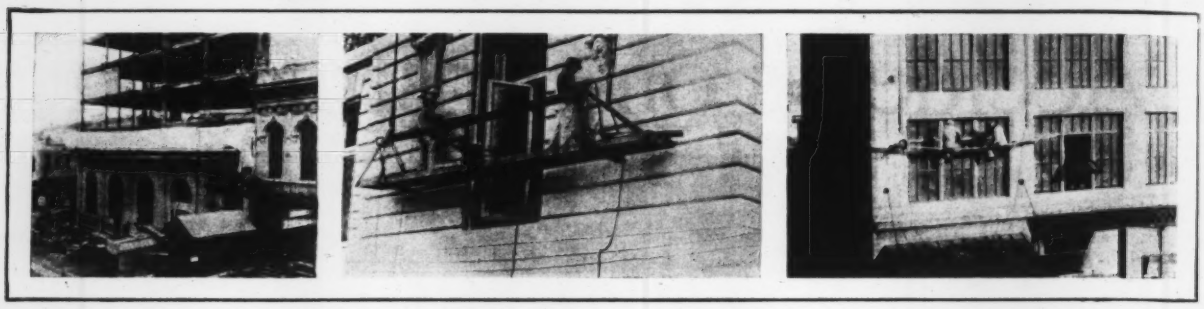
B: Injuries resulting from the collapse, tipping or falling of scaffolds, stagings, ladders, walls, and all false work, due to inadequate support, flimsy construction or defective lumber or overloading of same. Included in this group also are injuries resulting from falls into unguarded floor openings, elevator shafts, or due to lack of flooring in buildings or other structures in course of construction. (Nine of the accidents listed were due to pile drivers and bulldozers in 1914, and 18 similar accidents occurred in 1915.)

C: Injuries resulting from the falling of material which has been previously piled or which is in the course of being piled and which falls due to improper foundations or due to being improperly piled.

D: Injuries due to careless storing or handling of explosives.

E: Injuries resulting from the overloading or overstraining of ropes, cables, or slings which are used in all class of hoisting apparatus, such as derricks, cranes, etc.

From the average amount paid for compensation and medical fees per accident, it is computed that the 419 fatal accidents for the three years cost $460,900; the 676 serious injuries, $498,043; the 34,811 slight injuries, $811,096.30, making a total of $1,770,039.30. The slight injuries resulted also in the loss of 591,787 days.



A GOOD SHELTERED BUILDING SCAFFOLD, A GOOD OPEN ONE AND A VERY DANGEROUS ONE

Converting these figures into 300-day years gives a total loss of 1972 years. Assuming the average annual earnings for each man as $900, the loss sustained by these men amounted to more than $1,750,000.

Half the Accidents Are Preventable

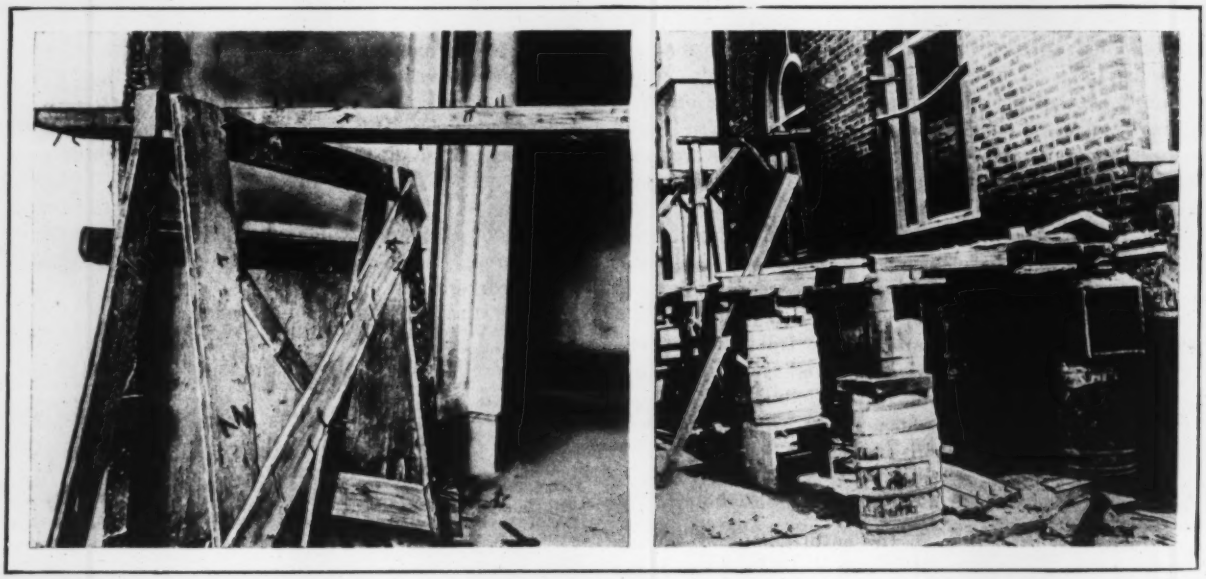
It is the general opinion of the engineering profession that half of the accidents which occur are preventable. If the compensation and medical fees alone could have been reduced 50%, $885,019.65 would have been saved to the employers of California in the past three years. Then, too, if one-half of the accidents were preventable, 210 lives might have been saved and the wage earners in 210 families would still be at work providing for those dependent on them.

Adequate safeguarding would also reduce the rate on compensation insurance premiums which under present conditions is exceedingly high, just as fire insurance is mostly materially reduced for those who take steps to safeguard against fire. Most of the accidents represent a great economic and social waste, for the cost of safeguarding is very slight.

Detailed Costs of Precautions

To give some illustrations: The twelve-story Santa Fe building recently constructed in San Francisco, a structure 45 x 90 ft., costing $350,000, involved the following costs for safety measures: Five temporary floors used by the steel erectors, to protect them from falling and as a protection from falling materials, at $111.76 per floor; twelve double ladders at $1.50; 135 ft. of suspended safe scaffolding, used by bricklayers, at 33 cents per foot; a 5 x 5-ft. tower, 196 ft. high, with cage for hoisting materials, at $1.25 per foot; guarding 24 openings, 6 x 11 ft., for elevator shafts and stairways, with railings 3 ft. 6 in. high, at $1.50 per foot; 135 ft. of temporary enclosed sidewalk at $1 per foot.

The total cost of safeguarding 175 workers who were engaged in building this structure for a period of six

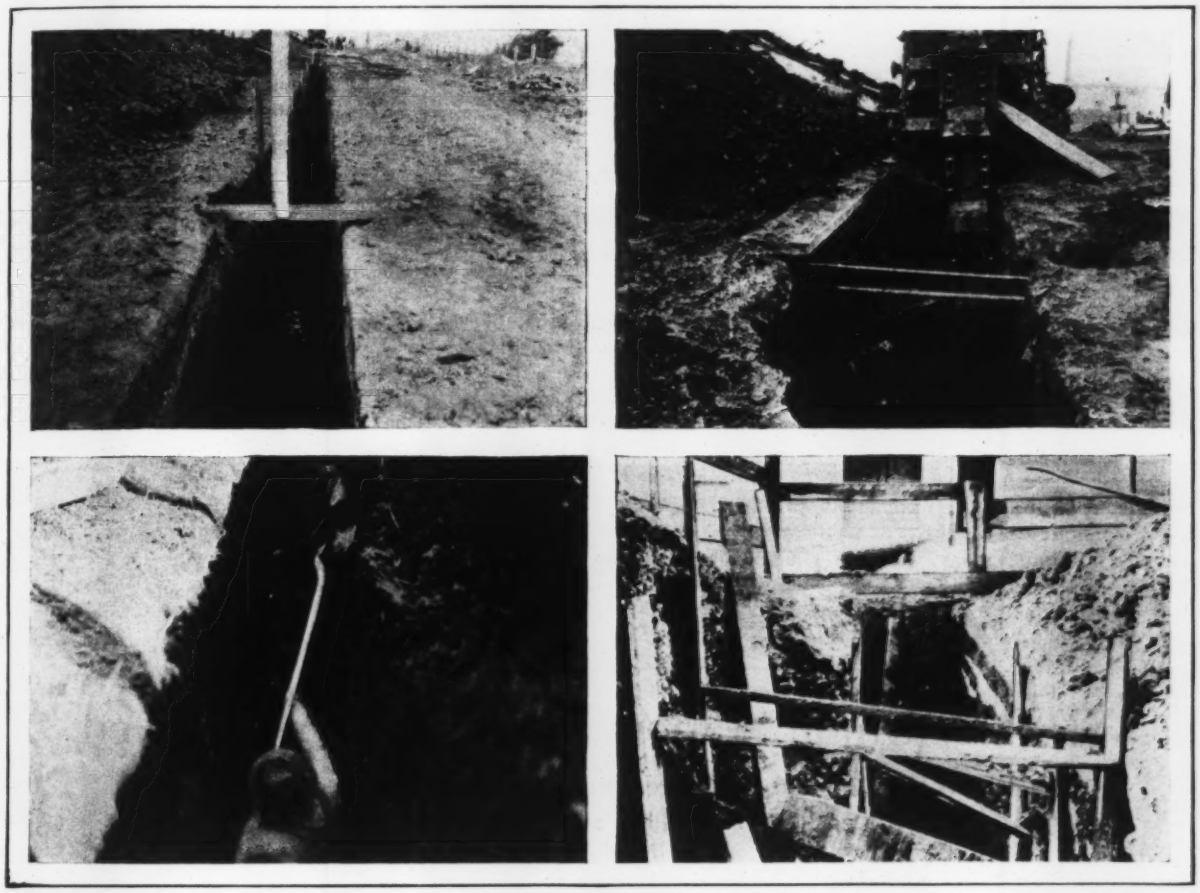


SUCH TRESTLES AS THESE ARE A DANGER TO LIFE AND LIMB, YET THEY ARE COMMON

months was $1032.35, or $5.89 for each worker. If a fatal accident had occurred to a laborer it would have cost the contractor $2700 for compensation; or if a mechanic had been killed, it would have cost $5000. These sums of money represent only the economic loss. They would not pay for any life, nor relieve the mental sufferings of those dependent upon the worker. Past statistics show

a fatal accident for each story above the tenth on a building over ten stories high. On the Santa Fe building, however, there was neither fatal accident nor permanent injury and only one slight accident.

Taking an example from another class of construction: A sewer system involving 30½ miles of 8 to 30-in. vitrified and concrete pipe placed at depths from 5 to 18 ft., and costing $250,000, was completed at Stockton and Hanford by Chambers & Heafey, general contractors. The cost of bracing, shoring and sheeting this work was $12,000. About 3500 men were engaged on this work for a period of 12 months and no fatal accident or permanent injury occurred and there were only a few slight injuries. Such results as these are accomplished through careful and frequent inspections by safety engineers and coöperation of employers and employees.



HOW NOT TO DIG NARROW TRENCHES. THE ONE ON THE UPPER LEFT HAND COLLAPSED AND TIED UP THE EXCAVATION AS SHOWN AT THE RIGHT

Contractors' Carelessness

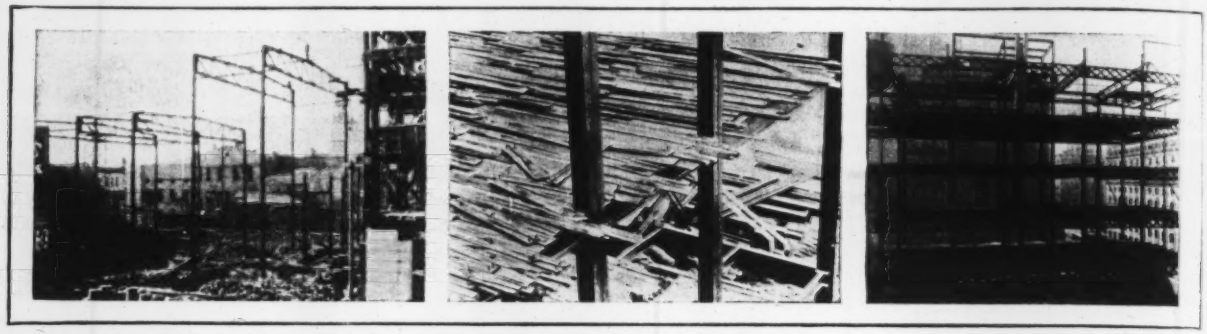
Considerable difficulty has been met with in inducing contractors to safeguard construction work. There seem to be several reasons for this. First, the keen competition in bidding causes contractors to disregard calculations for safety in order to offer the lowest bid. Such employers object to the expenditure of any money for safeguarding on the ground that they did not figure on it in their bids.

Second, the constant changes in the nature of the work as construction progresses make each stage so temporary that the contractor is tempted to evade safety provisions such as bracing and shoring excavations and providing rigid scaffolds, falsework, etc. He argues that it does not pay for such a short time. Third, the speed and high pressure under which most construction work is carried on cause the contractor to avoid anything which seems to him to retard the progress of the work.

Fourth, the workmen themselves are often averse to bothering with safeguards. In their impatience to get ahead they will often use weak material because it happens to be nearest at hand. The writer has seen the use of six-penny nails instead of 20-penny nails, 1-in. boards instead of 2-in., defective lumber used on scaffolds and falsework, and general experience in California bears out the truth of the statement that 50% of accidents can be prevented.

Serious Accidents on the Decrease

On the whole there has been a considerable decrease in serious and fatal accidents on construction work in California since the safety department began its "Safety First" campaign. Contractors are realizing that it pays. For example, when a scaffold or any falsework collapses there are five distinct effects: (1) The direct injury to the person or persons who fall; (2) the psychological effect on the workers who witness the accident and loss of efficiency therefrom; (3) the delay due to the temporary cessation of work and the necessity of rebuilding the



AN UNPROTECTED STEEL SECTION, A FEEBLE ATTEMPT AT TEMPORARY FLOORING AND A WELL-PROTECTED FRAMEWORK

structure; (4) increased cost of the work and the compensation and hospital fees of the injured; (5) the increased cost of insurance if such accidents occur repeatedly or a big loss if not insured. Much has been done in this field in California but there is still much to be done in the way of educating both the employer and the employee in the "Safety First" movement.

The New Safety Orders

In line with its policy of extending supervision to all fields of construction, the Department of Safety of the Industrial Accident Commission last year undertook to draft a safety code which would effectively cover the construction field. At first there was prepared a tentative draft of general construction safety orders. This was submitted to a committee in San Francisco composed of representatives of engineering organizations, the general contractors, architects, board of public works of the city, and the Building Trades Council of the state. After being passed upon by this committee, the orders were referred to a similar committee in Los Angeles. In revised form, but before final adoption, they are now being sent to contractors, engineers and architects throughout the state for criticism and suggestion. The ultimate purpose is to have the safety orders embodied in a state law.

Meantime, the draft of the safety orders in its present form is being enforced by the commission. If any employer considers the provisions unreasonable he may petition the commission for a hearing, after which if the order is found to be unreasonable, the commission is required by law to substitute such other order as may be deemed just and equitable.

As now revised, the safety orders cover all branches of construction, with detailed provision for safety measures that must be observed on each class of work. The orders require the protection of workmen in trenches, on scaffolds, when working underneath superstructures, and the use of temporary floor planking and safety nets in structural work and the guarding of openings between floors. Detailed attention is given to the methods in which workmen may handle explosives, the demolition of buildings, the piling and storing of materials, and in fact wherever personal risk is involved.

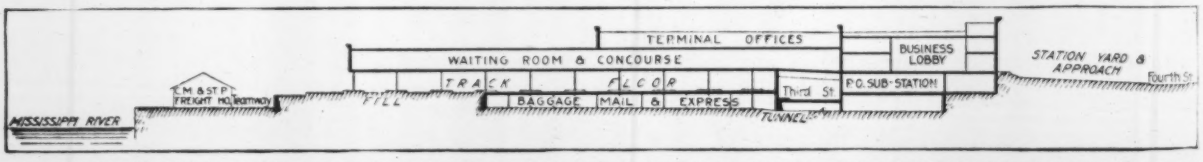
St. Paul Union Station Plans Finally Approved

Tracks To Be Elevated, with Headhouse on Fourth Street—Twenty-two Passenger Tracks To Be Provided—River Channel Not To Be Changed

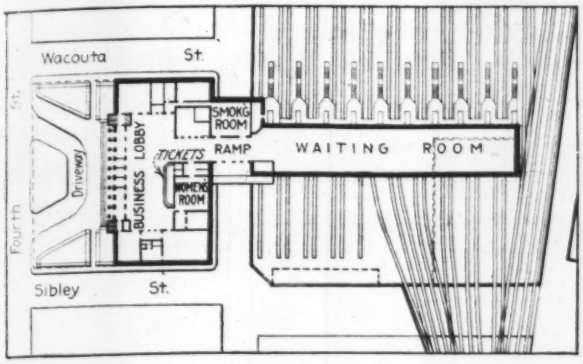
TWENTY-TWO passenger tracks, of which 14 will be through and 8 stub tracks, are to be provided in the new Union Station at St. Paul, the plans for which have been finally approved. The tracks will be elevated to pass over two cross-streets, while the main waiting room will be a long narrow concourse passing over 19 of the tracks. The headhouse will face 4th St., 3d St. passing underneath the concourse. The plans have been developed on the basis of no change in river front, as the railway companies found themselves unable to reach an agreement as to a proposed change of alignment of the Mississippi River. The total cost of the improvement, including land, is estimated at $11,000,000. It is expected that contracts will be let soon.

Project Long Under Negotiation

The history of this extensive railway-terminal project may be reviewed briefly. For several years the reconstruction of the old station had been under consideration, but no definite plans were adopted—mainly because of the difficulty of harmonizing the ideas of the various railways and the city authorities. Not only were the facilities outgrown, but the existence of busy tracks at the street level was an undesirable condition. The burning of the



TRANSVERSE SECTION—SPACE UNDER TRACKS WILL BE UTILIZED—THIRD STREET WILL BE CARRIED THROUGH



WAITING ROOM IS OVER TRACKS

old station building, or headhouse, in October, 1913, made some action necessary. The work was intrusted to a committee representing all the railways, and plans for a new station were originally approved by the railways and the city early in 1915 (*Engineering News*, Mar. 11, 1915). These plans called for the expenditure of about $15,000,000.

The present site lies between the river bank and the buildings along the south side at 3d St. The river makes a long bend through low ground at this point, and in order to enlarge the station site the 1915 project provided for the straightening of the channel and the utilization of the ground thus reclaimed. This alteration in the river channel required the approval of the United States War Department; but objections were raised by the Chief of Engineers, who also proposed certain conditions as necessary to his acceptance of the plans. The railway companies felt they could not comply with these conditions and therefore abandoned the project as planned at that time.

Plan as Approved

It was necessary then to start anew and prepare plans considering the river channel as an established limit. The present plan, as approved in February, 1917, is shown in the plan. The station yard is to be widened by the purchase of property on its north side, making 3d St. the boundary. An entire city block on the opposite side of this street will form the site of the main part of the headhouse, or station building, which will be connected with the rest of the station by both a tunnel and a bridge.

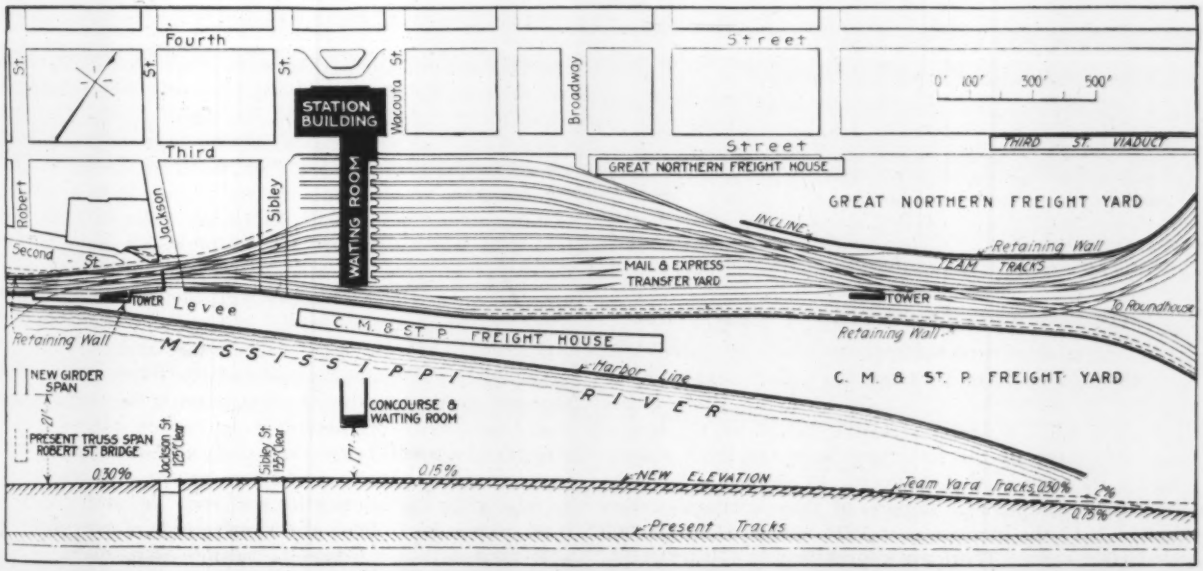
The tracks will be elevated through the terminal, being carried on a solid fill between concrete retaining walls, except where space is provided beneath the tracks for baggage, mail and express facilities. The profile is shown. The tracks in the new station will be about 17 ft. above the present tracks (at the street level).

Two streets now crossed by numerous tracks carrying heavy traffic will be carried beneath the line by subways giving clear access to the waterfront, where there is a public levee for steamboat accommodation. The Robert St. bridge will have to be raised, the present truss span across the tracks being replaced by two girder spans giving a clear headway of 21 ft. above the rails.

Twenty-Two Passenger Tracks

The track layout of the station provides for 22 passenger tracks and 2 freight tracks, while in addition there are 2 outside freight tracks of the Chicago, Milwaukee & St. Paul Ry. There will be 8 stub tracks for the use of trains for which St. Paul is a terminal point. All the others will be through tracks. The station tracks will be spaced alternately 29½ and 12½ ft. c. to c., the 11 platforms being 19½ ft. wide and from 900 to 1100 ft. long. The present station has 14 passenger tracks.

The east approach is a Y, as at present, with 3 tracks on the southern leg and 6 on the northern leg, uniting in a 7-track throat from which the 22 station tracks diverge. This has a system of ladders with double-slip connections, using No. 8 frogs. On one side of this throat is a pair of team tracks with paved driveway 850 ft. long. On the other side, and just in front of the station, is a mail and express transfer yard for interchange between cars of different roads. This has 5 tracks spaced 23½ ft. c. to c. At the west end of the station the 14 through passenger



ELEVATED LAYOUT CALLS FOR 22 PASSENGER AND 4 FREIGHT TRACKS

tracks and the 2 freight tracks converge into a 4-track main line.

The tracks in the station yard are from 800 to 1800 ft. long and aggregate nearly 5 miles, while the total length of tracks in the terminal will be about 12½ miles. The distance between the points at which the new line will meet the old line is about 1⅜ miles. There will be a large interlocking switch and signal tower at each end of the station. East of the station and in the open space of the Y approach are a four-stall engine house and other facilities for the switching and transfer engines. The several railways have their own car-cleaning and storage yards and facilities for road engines, outside of the new terminal.

The station building is an independent part of the terminal, separated from the station yard by 3d St., which will be 58 ft. wide. Its site occupies an entire block, as shown, but part of this will form a broad driveway and approach opening upon 4th St., so that the cab and carriage service of the station will be out of the way of street traffic.

Building Arrangement

The building will be about 150 x 300 ft. The ticket office and other main facilities will be practically on the level of the 4th St. entrance. An upper floor will contain offices, kitchen, and restrooms for women. Two lower, or basement, floors will provide for station facilities, immigrants' quarters, branch post office, etc. As the main floor, entered from 4th St., is about 26 ft. higher than 3d St., this permits the latter to be spanned by a bridge carrying the smoking room and a connection with the main waiting room. This room, with the concourse, forms a separate structure 80 x 400 ft., extending across the tracks, with an elevator and stairway at each platform. The general arrangement is shown by the cross-section.

The station building will be of reinforced-concrete construction, with steel girders spanning the business lobby in which the main facilities are located. The waiting room will be a steel-frame structure, supported on columns on the platforms. Beneath the track floor a space of about 260,000 sq.ft. will be utilized for baggage and mail rooms and quarters for six express companies, with toilet-room, washroom and locker accommodations. There will also be driveways and truckways, and elevators serving each of the station platforms. Over this space the track floor will be carried by reinforced-concrete construction.

The terminal is under the management of the St. Paul Union Depot Co., which represents the nine railways using the station. The plans for the new station have been prepared by W. C. Armstrong, chief engineer. The architect for the station is Charles S. Frost.

Irrigated Area Increasing in California

An increase of 1,000,000 acres to the irrigated area in California could be made by the end of next year, according to a statement recently made by Prof. Frank Adams of the University of California, if all the irrigation companies of the state can show the same proportionate increase as that indicated by estimates for 1917 filed by 86 companies. Reports of these companies show that in 1917 the increase over 1916 will be from 300,000 to 350,000 acres. There are approximately 450 irrigation companies in the state.

Finding Water Used To Irrigate Mountain Hay Land

A Study in Valuing Water Rights Near Denver, Colo.

By M. E. BUNGER
Civil and Irrigation Engineer, Denver, Colo.

INVESTIGATIONS for a new water-supply for Denver, Colo., led to the consideration of the amount of water that might be derived from the purchase of water rights used in the irrigation of hay meadow lands situated in the mountains about 50 miles southwest of the city at an elevation of 8500 to 9500 ft. These meadow lands are covered with a wire-grass sod varying from 6 to 18 in. in thickness and are underlain with a porous gravel stratum. The flooding system of irrigation is in use, as shown by the accompanying typical irrigation scene in this locality. As the city would be allowed to divert only the amount of water that was actually lost in the process of irrigation, an attempt was made to ascertain this loss during 1916 as a basis of estimate.

Three Sections Chosen

Three sections in different parts of the irrigated area were chosen. One was selected where the losses would be a maximum, as the water was taken quite a distance from the stream and several days would elapse before it would run over the meadows and return to the stream. This area is designated the Kester Sweet area in the summary table. Another area, named Tarryall, was one where the loss would be a minimum, as the water was taken out to irrigate only narrow strips of meadow extending along the banks of the stream. The third or Antero area was one where the losses would represent as nearly as possible an average for the entire irrigated area, as it contained some hay land the waste water from which never got back to the stream and some narrow strips where the water got back immediately.

Complete surveys were made of the three areas. The amount of land subject to irrigation under each ditch was determined. Automatic registers were placed in the streams above and below each area, and staff gages were installed in all ditches. Gage observers were employed to look after the automatics and read the staff gages at least once a day. They also kept records of precipitation and temperature. Complete ratings were made of all stations, and very good curves were obtained.

Practically no rain fell during the 1916 irrigation season (June, July and part of August), so that the records were not affected by a varying run-off, which would have been difficult to determine.

From a study of the detail records of these areas it was noted that for periods when a maximum amount of water was being used the losses in acre-feet were materially less than when a smaller amount was applied. This is believed to be due to the greater velocity with which the water ran over the surface and to the lowering of the average temperature, as the water in the stream was very much colder than the water that stands on the meadows for any length of time. For example: During the last 15 days of June (weather and temperature conditions being uniform throughout the month and the stream flow being such that the Kester Sweet area could receive a maximum head of water) the use was 1.9 acre-feet per acre and the loss 0.63 acre-foot, while for the first 15 days of June the stream flow was such that the use was only 1.1 acre-feet per acre and the loss 0.94. The stream flow for the year 1916 was about 95% of an average for the 14 previous years.

It therefore seemed fair to conclude that for years of more than normal stream flow the decrease in loss over that of an average year would be made up by the ditches diverting water for longer periods; and in years of less than normal run-off, while the rate of loss would be higher than during the 1916 season, the total for the season would be about the same, due to the shorter time the water could be diverted. Accordingly, the seasonal loss as determined by this investigation, less 10% for return seepage that comes into the stream after irrigation ceases, would probably represent an average for all seasons. The 1916 seasonal loss of about 1.7 acre-feet per acre irrigated was therefore used as a basis.

IRRIGATION LOSSES ON HAY MEADOW LANDS IN MOUNTAINS NEAR DENVER, COLO.

Month	Average Acres Irrigated	Total Acre-Feet Used	Total Acre-Feet Lost	Acre-Feet per Acre* Used	Acre-Feet per Acre* Lost	% Used
KESTER SWEET, OR MAXIMUM-LOSS, AREA						
June	540	1,616	846	3 00	1 57	52 3
July	540	739	370	1 37	0 68	49 6
August	540	776	355	1 44	0 66	45 8
Total for season	540	3,131	1,571	5 80	2 91	50 0
TARRYALL, OR MINIMUM-LOSS, AREA						
June	667	2,460	309	3 69	0 46	12 6
July	474	2,100	280	4 43	0 59	13 4
Total for season	667	4,560	589	6 84	0 88	12 9
ANTERO, OR AVERAGE-LOSS, AREA						
June	1,173	3,705	1,671	3 16	1 42	44 9
July	574	1,055	417	1 84	0 73	40 0
August	112	154	83	1 38	0 74	53 6
Total for season	1,173	4,914	2,171	4 19	1 85	44 2

* The loss and use in acre-feet per acre is based on the maximum acres irrigated.

Convict Labor on Municipal Work

Last year, Omaha, Neb., farmed out many of its prisoners to municipal contractors in squads as large as 20 men. Of the 25c. per hour paid for their labor, 10c. was placed in a benefit fund that went to the man upon the expiration of his sentence. The city furnished all necessary guards; and not only was no trouble experienced with the convicts, but the contractors found several very decided advantages in their use. Chief among these was that the labor supply was dependable, although the city authorities insisted that the contractors hire free labor whenever it was possible.

Timber Structures in Hawaii Menaced by Marine Borer

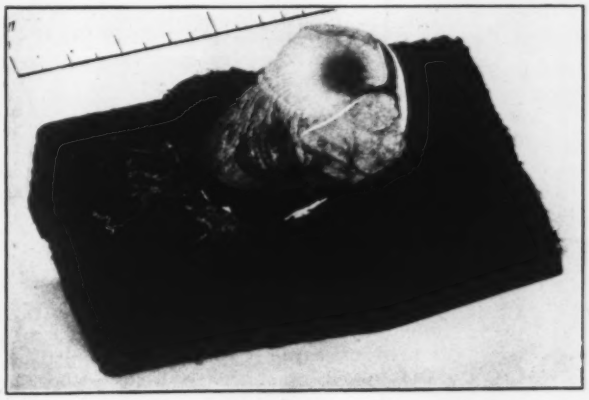
Navy Department Discovers Rare Specimen That Makes Round Hole Nearly Inch in Diameter

A HEAD-ON VIEW OF MARTESI XYLOPHAGA

A MARINE wood borer of known zoölogical classification but of rare occurrence has been causing considerable trouble in the timber structures around the Hawaiian Islands and has been studied by the Bureau of Yards and Docks of the United States Navy. The views herewith show one of the finest of the specimens which were taken from some timber near the Pearl Harbor dry dock.

According to the experts of the National Museum the Mollusk belongs to the Genus Martesia, and is apparently *Martesi xylophaga* C. B. Adams. The animal in its grown state is mostly a spheroidal head approximately ¾ in. in diameter with a tapering body about 1 in. long, all of shell. In action the bivalvular head opens to permit the crosswise motion of a hard and rough tongue which working back and forth cuts a clean round hole through any tar paper covering, asphalt protection and the wood structure itself. It is stated that it will even eat into rock although metal sheathing seems to be too much for its efforts.

The borer starts a hole about ⅛ in. in diameter which increases in size as it enters the wood until it reaches its full growth of about 1 in. as shown in the views. It is thought that the animal makes the hole only as a retreat and not to get food, but the depth to which the hole will be made or the lowest limit of its activities are not known. It is particularly objectionable because it is not impeded by many of the ordinary timber protective devices and apparently necessitates the use of metal sheathing in the waters it infects. It is stated by the Bureau that similar action has been noted in some of the Cuban Stations.



BORER IN INCH-WIDE HOLE THROUGH WOOD AND ASPHALT

Failure of Hydraulic Projects from Lack of Water Prevented by Better Hydrology

Engineering Analysis Substituted for Guesswork

First of Three Papers Teeming with Constructive Suggestions for Analysis of Complicated Problems Where Reliance on Mass Judgment Has Prevailed Before—The Editor

More Complete Study of Stream Yield Is First Step—Low-Flow Frequency, Degree of Flashiness and Dry-Weather Evaporation Cannot Be Neglected

By ROBERT E. HORTON

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IT HAS BEEN aptly remarked by *Engineering News-Record* that "a reasoned study of data is capable of much use in a great number of cases where we tend to rely on sheer judgment." To no engineering effort is this more applicable than in the hydrologic features of design, which are entitled to more elaborate and painstaking analysis than they have hitherto received. True, the work is laborious and the procedure often complex, when viewed as a whole; and trained judgment and experience are largely involved. But the difficulties of a task do not excuse its non-performance.

Failures Through Small Yield

In the development of water-power, water-supply and irrigation projects, the results realized have frequently fallen short of the anticipated, owing to the water-supply being less than estimated.

In not a few instances such failures have been the fault of the engineers, who have, even though unintentionally and inadvertently, overestimated the available yields of the streams with which they were dealing. In other instances the average yield and even the minimum yield of the stream may have been correctly estimated, but owing to the unfortunate occurrence of a period of dry years during the critical time when the project was struggling to get on a paying basis, the result has been failure.

These last occurrences, even though in no way the fault of the engineers, have contributed to the quite general tendency among investors and financial agencies to scale down, discredit or accept with skepticism all estimates of available yield of drainage basins—and especially those made for the development of water power or irrigation.

Better Estimates of Yield

The phenomena of stream flow are complex, and experience leads to the belief that *engineers do not realize fully the difficulties of making reliable estimates of stream yield from such data as are ordinarily available.* Certainly, laymen bankers and investors cannot be expected to realize fully the difficulties involved or the nature of the results attainable. They do not understand that there are no fixed and definite methods or formulas by which certain and invariable conclusions may be reached—as certain, for example, as in the design of bridges or other steel structures.

For dependable results it is necessary to find the simple elements of each complicated problem and treat them separately. More accurate judgment can be passed on a question involving a single element of uncertainty than where a subject involves many such elements. Moreover, the gross error from the summation of these analyses is less than for one grand guess, since the individual minor errors are apt to counterbalance.

Employ All Available Data

Two general principles may be followed for each element of a problem:

1. The best possible use should be made of all the available data in a manner consistent with the importance of the result to be obtained.

2. The results should be made to depend directly on the data, so far as possible, avoiding all unnecessary interpolations and assumptions.

To handle such problems in the best manner requires experience and trained judgment. In these matters the judgment, to a marked degree, can be cultivated and improved by experience. Where the results are at all important, there should be no hesitation to employ the best talent available.

Few engineers engaged in general practice, or even in hydraulic practice in other lines, have specialized in hydrology. It may be said with certainty, however, that there is no reason why there should be serious failure or disappointment in the majority of cases, even with the present somewhat limited knowledge of hydrologic matters, if estimates of yield are made by men fully conversant with the subject and competent to handle it and *if the results of their studies are put in such shape as to avoid misconception of their meaning.*

In this last lies one of the great sources of trouble. The prospective investor in a water-power or irrigation

project generally wants to know: (1) The net average output available; and (2) the minimum output available in a dry year. Now it may happen that the first few years after the construction is completed will be phenomenally dry years—and, so far as the writer is aware, it is impossible at the present time to forecast even what the immediate future holds in store as to weather conditions and yield of streams.

While there undoubtedly is, in most cases at least, some fixed limit to every phenomenon beyond which nature never ventures, yet to determine these limits with absolute certainty seems at present impossible. In a certain locality there may not have been a rainfall of less than 20 in. in any year in a century. Yet no one can say with certainty that the rainfall in the next year will not go down to 18 or even 16 in.

Frequency an Important Criterion

The foregoing suggests at once a remedy for one of the sources of trouble in connection with estimates of stream yield.

The minimum yield of a certain stream as estimated by one engineer may correspond in fact to a yield that will be realized on an average once in 10 years, while the estimate of another engineer, more conservative, may correspond to a yield that will be realized on an average only once in 50 or 100 years.

It is not difficult in most cases where the data are fairly complete to determine the probable average frequency of occurrence of any hydrologic event, such as a maximum rainfall intensity, maximum flood discharge, minimum annual rainfall or minimum monthly yield of a stream. Such calculations may be made either by use of the ordinary Gaussian law of error or by the use of special probability curves. The latter method is much to be preferred wherever the available data permit its application.

If estimates of the minimum yield of streams for water-supply, power or irrigation were generally accompanied by statements of the average frequency of recurrence of yields equal to the given values, it would lend a degree of definiteness to the results and would facilitate logical comparisons of different estimates of the yield of the same stream or of corresponding phenomena relative to the yield of different streams.

Data May Not Reveal Frequency

For example, two streams have been gaged, one for a period of 10 years, another for a period of 20 years. One of them shows a minimum yield for one month at the rate of 0.2 sec.-ft. per square mile. The other, having the shorter record, shows a minimum yield of 0.4 sec.-ft. per square mile. The data do not of themselves reveal frequencies of occurrence of these or lesser minima; and it cannot be said directly that one stream has twice as great a minimum yield as the other, although such conclusions are not uncommon. Analyzing the data by the method of probabilities, it may be found that yields of 0.2 sec.-ft. per square mile will *probably* occur on the average with equal frequency in the case of both streams, and an estimate of the minimum yield of either one should be accompanied by a statement of the *probable* frequency with which equal or lesser minima are likely to occur.

Another common source of trouble in water-supply estimates, especially for power, is the failure to take into account the character of the regimen of the stream, whether it is flashy and torrential, on the one hand, or uniform and steady, on the other.

Variability or Flashiness

The fact is commonly recognized that the more uniform the regimen of a stream, other things being equal, the greater its value for power. The reason commonly assigned is that in the case of a steady stream the range of fluctuation is usually less than in the case of a flashy stream, and consequently the proportion of the total annual yield that can actually be utilized is greater in the former than in the latter case.

But there is another aspect of this variability which is of perhaps equal importance, of which nothing seems to have been written heretofore. Its character is very illusive. It is difficult to grasp in such a way as to reduce to quantitative terms its effect on the value of a stream for power. This is the frequency of change of stage.

Consider two streams whose maxima and minima are equal, whose drainage basins are equal and whose total annual run-offs are equal. Let one of these streams be naturally so regulated that it has throughout each year one, and only one, high-water period; and one, and only one, low-water period—streams such, for example, as the Oswego River, or the Lake Champlain outlet. Let the other stream have such a regimen that it changes from a rising to a falling stage, or vice versa, say 100 times per year, the flow being "up one day and down the next," as the saying is. Assume a certain plant capacity the same for each stream, each plant capacity being some definite percentage of the average stream flow.

For the steadier of the two streams it may be possible to utilize 85 to 90% of the total available flow for power purposes. In the case of the flashy stream it might be difficult under certain conditions of power use to utilize more than 50 to 60% of the available flow for power purposes. By available flow is here meant such portions of the flow of the stream as are not in excess of the plant capacity.

Distributed Flow and Usable Flow

The distributed-flow or frequency-curve method of analysis of the yield of a stream for power or other purposes determines the available flow and furnishes a means of comparison of the relative available flows of different streams. It does not, however, furnish a means of comparison of the actual usable flow. This latter factor depends, first, on the flashiness or variability of the stream; second, on the manner of its utilization. For some purposes, the usable flow of a given stream would be a much larger proportion of the available flow than for other purposes.

Some confusion has arisen through lack of adequate precaution and through attempts to base estimates of the usable flow of streams on considerations of the load factor of the power plant. If the power plant has immediate storage or extensive pondage, there may be very little relation between the two quantities. If the power plant has no extensive storage or pondage, but is obliged to utilize the natural run of the stream as best it can

day by day as it comes along, the load factor may exert a governing influence on the usable flow.

Monthly Yields Are Misleading

An exceedingly common source of error, and sometimes a very serious error for power estimates, arises from the basing of such estimates, otherwise wholly reliable, on average monthly instead of daily yields. During former years there were few stream-flow data available, and estimates of stream flow had to be derived largely from rainfall data. There was some excuse for such monthly estimates, because it was then, and is now, for that matter, practically impossible to formulate a reliable estimate of the yield of a stream day by day from rainfall alone. Within very recent years the United States Geological Survey has shifted over to the practice of publishing daily discharges of streams at gaging stations instead of giving only monthly discharges, as heretofore.

Even where daily discharges are not directly available, engineers will frequently find it worth while to compute the daily discharges from rating tables and gage heights, at least for critical periods, to avoid errors. The errors mentioned arise from the fact that, where monthly yields are used, all the flow during a given month is included in making up the average. The resulting average may be less than plant capacity and hence apparently all available flow. In reality the flow on certain days during the month may have been greatly in excess of plant capacity; and if this excess flow was excluded, the average usable flow would be greatly reduced.

For very steady streams the difference between yields based on monthly and daily flows is, as a rule, comparatively slight. For torrential and flashy streams the difference between the available flow estimated from monthly and daily records may amount to from 10 to 15%, or perhaps more in some cases. If, therefore, daily flows are not available or the labor of computing them does not appear to be justified by the value of the results, *a deduction from the available yield as determined from monthly flows should in general be made*, its amount depending on the character of the regimen of the stream.

Errors from Assumed Evaporation

Another not uncommon source of error in estimates of stream yield is neglect of the very important seasonal effect of evaporation. A common rule among engineers in the Eastern states in estimating the available yield of streams containing lakes or other extensive water surfaces is to base the estimated yield upon the net land area. That does very well where the annual rainfall is about equal to the annual evaporation, so far as estimates of annual run-off are concerned.

It is, however, nearly always preferable, especially if the minimum flow of the stream is of any consequence in the estimate, to take into account the yields and losses from the water surfaces month by month. Consider, for example, a drainage area of 110 square miles, on which power is to be developed in conjunction with a storage reservoir of 10 square miles surface area. If the average flow of the land area in the driest month of the year is ¼ sec.-ft. per square mile, then if an estimate is made, excluding the water surface altogether, the result would indicate that a yield of 25 sec.-ft. might be derived from the drainage basin during the driest month of the year without draft from storage.

Even though, as here assumed, the annual evaporation equals the annual precipitation, it is likely to be true that the evaporation during the driest month of the year is very greatly in excess of the same month's precipitation. If, for example, the evaporation during the driest month of the year is 6 in. and the precipitation only 2 in., then, since 1 in. of rain on one square mile is equivalent to a flow of 1 sec.-ft. for 26.889 days, or, in convenient terminology, 26.889 sec.-ft.-days, then the total draft from the storage reservoir during the given month to supply evaporation losses alone will be 1075.56 sec.-ft.-days. This is equivalent to 35.8 sec.-ft. for a month of 30 days, so that not only would the entire inflow to the reservoir be consumed, but there would be required in addition an actual draft of 10.8 sec.-ft. throughout the month from storage to make good the evaporation losses.

Where the reservoir areas are appreciable, an attempt should be made to find the surface evaporation; how the problem can be logically attacked the author showed in an earlier paper, "A New Evaporation Formula," *Engineering News-Record*, Apr. 26, 1917.

Estimating Yield from Rainfall

Thus far it has been assumed that there are complete and adequate data on which stream-yield estimates may be based. This is indeed an unusual condition. In the great majority of cases one of the following conditions exists:

1. If the stream in question has been gaged, the records are not of sufficient duration to cover the ordinary irregular cycle of wet and dry years, or else they are incomplete and fragmentary.

2. Many cases arise where there are no gagings of the stream for which the estimate of yield is required, but gagings are available for other adjacent and more or less dissimilar drainage areas.

3. There may be no gagings whatever available applicable to the stream in question, and estimates of yield must be deduced from other data.

Good estimates may be made in most such cases, as will be noted in subsequent discussions; but the methods of procedure must vary according to the nature of the data available. Indeed, it will be seen that the new hydrology is largely a matter of methods rather than of fixed rules and formulas.

Subsequent articles will continue this presentation of the new hydrology by discussions of weighting rainfall records, interpolation for missing rainfall data, effect of time distribution of precipitation, conduct of drainage-basin inspections, effect of various crops, etc.—Editor.

Public Work at Private Expense

As an example of the coöperation which may be secured on a purely voluntary basis it is noteworthy that, at no cost to Vermilion County (Ill.), more than 6 miles of fences have been moved from 2 to 10 ft. on account of the state highway department's demand that state highways have a minimum width of 50 ft. Not only was the land deeded to the state without payment in any form, but the actual work of moving the fences was done by the farmers themselves, or by laborers employed by them.

Tanks Kept in Service During Repairs

Septic Tanks Reconstructed as Imhoff Tanks at Columbus

Sludge-Disposal Problem Forced Change—New Tanks Built While Half of Old Plant Was Kept in Service

Part II—Special Features of Design and Construction

By J. J. MORGAN

Consulting Engineer, Columbus, Ohio

THE recent remodeling of the sewage-disposal plant at Columbus is unique in that it is, perhaps, the largest undertaking yet planned for converting single-story septic tanks into tanks of the Imhoff type.

The first step involved a thorough survey of all existing conditions to determine whether it would be best to construct the new tanks inside of the septic tanks or to build them entirely separate and abandon the old ones. It was soon found that the new tanks could be constructed inside of the old ones at a much reduced cost over that of an entirely new plant. Further studies led us to believe that Imhoff tanks placed inside the old work would produce proper operation results, although it was necessary to depart from some of the recognized standards. The result of these studies produced what might be termed a remodeling of the old plant.

Excavate or Raise Walls?

The depth of the new tanks being 27 ft. from flow line to bottom of sludge compartments, while that of the septic tanks was only 12.5 ft., the question arose as to whether the additional depth should be obtained entirely by excavating below the old bottom or by building the old walls higher. As far as the plant itself was concerned, it would have been cheaper to have raised the elevation of the top, thus avoiding a 14-ft. excavation, 5 ft. of which would be below ground-water level. It was necessary, however, to consider another feature in this connection—namely, the cost of pumping the sewage to an additional height in case the flow line at the plant were raised. Calculations showed that it would cost approximately $1800 per year to pump the average flow of sewage to an additional height of 5 ft., which would mean 5% interest on an investment of $36,000. It was therefore found cheaper to excavate the entire 14.5 ft. below the old floor in order to obtain the necessary depth for the Imhoff tank.

In so far as possible, all the old construction was used unchanged in the new tank. The old primary tanks were 150 ft. long; and this length determined that of the Imhoff tanks, which were installed in this portion of the plant. These tanks are longer than it has been customary to build, but from the fact that the solid particles in the sewage are finely broken up in the pumps we have found this length desirable for good sedimentation.

We have 22 new tanks, averaging 26 x 130 ft. in plan. The plant is designed for a maximum flow of 50,000,000 gal., with an average flow of 35,000,000 gal. per day. The period of sedimentation at maximum flow is 2.46 hours, and the average is 3½ hours. This period can be shortened by cutting out some of the tanks.

The sludge compartments have a capacity of 276,000 cu.ft., which gives a storage period of 110 days based on a sludge discharge of 0.01 cu.ft. per capita per day and assuming a total population of 250,000. The sludge-drying beds have an area of 382 sq.ft. per 1000 population.

Special attention was given to the design of channels and conduits carrying raw sewage, so that the minimum velocity would not be less than 2 ft. per sec., in order to prevent sedimentation of the putrescible solids and eliminate septic action and objectionable odors from the channels. In practically all the old conduits that were placed in the new construction the cross-section had to be reduced to accomplish this result.

The settling tanks are divided into three separate batteries, each of which can be operated independently of the other two. The direction of flow is reversible in all tanks. Sludge is drawn off into concrete channels, which carry it by gravity to the sludge-drying beds. These channels have a minimum slope of 1.78 ft. per hundred; and although only a small amount of sludge has been removed to date, we have found the slope of the channels to be ample. Steel dump-cars will be used for the re-

moval of sludge, the cars being hauled by a gasoline locomotive to a point outside of the levee, where the sludge will be dumped.

To provide for the new work, it was necessary to remove 950 cu.yd. of concrete from the walls and floors of the old tank. Holes were cut through the walls, which were as much as 9 ft. thick in places. This was a difficult task, and the contractor found the most practical method to be by the use of a channeling machine. In this way he was able to cut the concrete to a line. Where new concrete walls intersect old walls running at right angles, a channel was cut about 3 in. deep in the old concrete to provide a tie between the two.

The 2-in. partitions forming the gas-vent walls are constructed of cement and sand applied with the cement gun. Alternate bids were received on this construction and on 6-in. concrete walls. The successful bidder named a price $1000 lower for the cement-gun walls; and this was accepted, although this method of constructing the walls had been tried elsewhere with indifferent success. The writer had had some experience with the gun on other work and did not see why it could not be used with good results in this case.

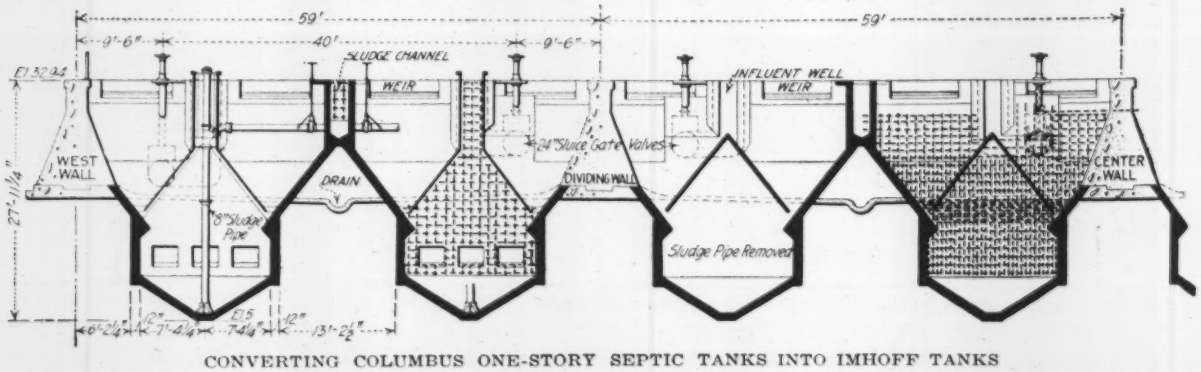
CEMENT GUN IS BUILDING UP GAS-VENT PARTITIONS IN IMHOFF TANKS

Cement mortar was plastered on reinforcing steel, then cement gun was used and finally surface was plastered

The specifications called for a reinforcement of expanded metal having rib stiffeners about 4 in. apart. We endeavored at first to place the gunite by erecting a temporary wood backing on the opposite side of the reinforcing material, so as to have something for the cement to build up against. The rebound of the sand, however, lodged in the ribs and between the form and the expanded portion of the metal, producing pockets of sand with very little cement. Several other methods were tried, but it seemed we could not eliminate the objectionable collecting of sand. We finally accomplished the result sought by plastering a very thin coat by hand over the openings in the expanded metal, using the gun to apply the material directly on the plaster.

The plaster was composed of one part of cement to three parts of sand, with a quantity of hydrated lime equal to about 15% of the volume of cement and enough hair to bind it together properly. The gunite was mixed in the proportion of one part of cement to three parts of sand, with about 8% of lime. The last coat was troweled thoroughly, so as to obtain a smooth finish. A few cracks have developed in these partitions, but they are nothing more than can be expected in any concrete work. They have been exposed fully to the severe weather conditions of the past winter and show no defects other than the few small cracks. The cement gun was used to advantage also in patching distintegrated places in the old walls.

During the spring of 1916 a flood caused the ground-water level to rise from Elev. 9 to about Elev. 20. One of the tanks had been completed up to Elev. 19, and the backfilling had been made around the outside walls. The ground-water flowed over the top of the side walls and filled the tank completely. A few days later the contractor commenced pumping the water from this tank, and after emptying one end it was discovered that this end of the tank had been raised 18 in., caused by the uplifting force of the water outside. The entire tank (130 ft. long) had been raised bodily without injuring the structure in any way. After an investigation it was found that the backfill had settled underneath the floor of the tank and was considered sufficiently well distributed to support the tank properly. No attempt was made to lower the structure to its original position, as this was deemed impracticable; and the upper portion was built according to plans. This tank has been filled with sewage for six months since its completion; and as far as can be observed, there has been no appreciable settlement.



CONVERTING COLUMBUS ONE-STORY SEPTIC TANKS INTO IMHOFF TANKS

Greater depth of Imhoff tanks obtained by carrying sludge compartment down beneath bottom of old settling tanks

The cost of the new tanks and sludge-drying beds, including engineering, when final payment is made, will be about $210,000, divided as follows: Imhoff tanks, including channels, conduits and chambers, $186,000; sludge-drying beds, $24,000. With an average flow of 33,000,000 gal. per day, the cost of the work will be $6350 per million gallons treated. It is estimated that an entire new plant would have cost in the neighborhood of $10,000 per million gallons treated, so that considerable saving was effected by using what we could of the old tanks.

The Columbus Division of Sewage Disposal is under the supervision of George A. Borden, director of public service, and Jerry O'Shaughnessy, superintendent. The construction work was in charge of C. B. Cornell, resident engineer, assisted by John M. Heffelfinger.

Old Conduit Breaks Alongside Trench for New Conduit

Flow Maintained by Sand-Bag Channel Until New Conduit at St. Louis Could Be Carried By

A BREAK in the main conduit of the St. Louis waterworks at a point where a trench for a new conduit close alongside was being dug occurred on the evening of May 14. The nature of the accident, its relation to the water service, and the means of repair will be more readily understood after describing the general scheme of the St. Louis water-supply.

Water is taken from the Mississippi River at the Chain of Rocks, opposite the northern city limits, purified and then delivered to two main pumping stations: The upper station, four miles below the intake at Baden, serving the higher levels of the city; and the Bissell's Point station, three miles farther down the river, serving the lower section. The main conduit broke between the two pumping stations, so that the water-supply to the Bissell's Point, or low-service, station was interrupted.

The conduit was reopened on the morning of May 16, the flow being carried through a temporary flume of sand bags and earth-fill. Meanwhile the lower district was served from the storage in the basins at Bissell's Point and by bypassing between the high-service (Baden's station system) and the low-service system of distributing mains.

FIG. 2. EMERGENCY SAND-BAG AND EARTH CHANNEL CARRIES WATER ACROSS BREAK IN ST. LOUIS CONDUIT

The original conduit, about seven miles long, is of heavy masonry construction. Between the Chain of Rocks purification plant and the upper pumping station at Baden, a second conduit, consisting of a 7-ft. steel pipe, was built about 1906. A contract was let about six months ago for another conduit between the two pumping stations, to be constructed of reinforced concrete. At the time that the break in the old conduit occurred, the work on the new conduit had proceeded for about a mile north of its lower end at Bissell's Point. The relation of the old and the new structures and a cross-section of both are shown by Fig. 1. Fig. 3 shows conditions at the break.

The break occurred about 100 ft. beyond the completed portion of the new conduit and at a point where the new conduit trench was almost completely excavated. The side of the old conduit had been exposed throughout this portion, and a small portion of the fill nearest to the new conduit had been removed. The water in the old conduit was flowing about 5 ft. deep. Both conduits at this point are built

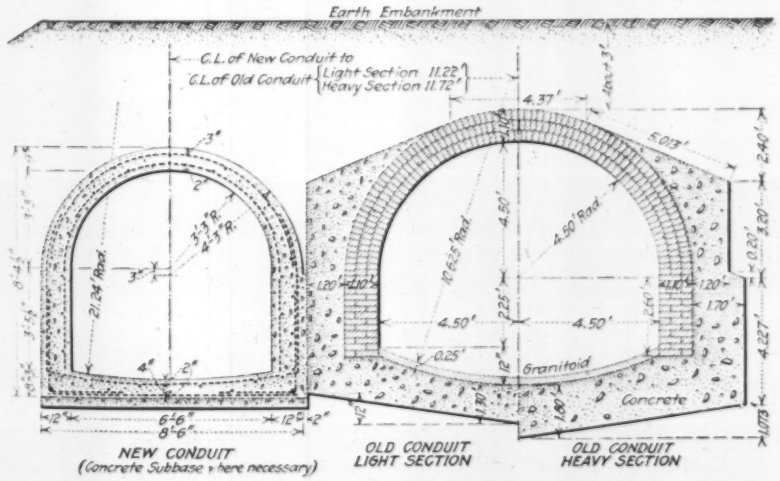


FIG. 1. NEW WATER-WORKS CONDUIT FOR ST. LOUIS BEING BUILT SNUG UP AGAINST OLD CONDUIT

FIG. 3. BREAK IN ST. LOUIS CONDUIT STOPPED FLOW
New conduit may be seen in right background

on an embankment. Although the embankment is about 30 years old, it is presumed that some slight settlement must have cracked the old conduit and permitted a leakage that saturated the ground under the exposed side, permitting further settlement and final collapse. The collapsed section is about 150 ft. long.

As it is impossible to repair the old conduit while in service, it is now proposed to maintain the flow through the temporary flume (Fig. 2), until such time as the construction in the new conduit can be carried past the break. The two structures will then be connected by a gate chamber and the flow carried through the new conduit while repairs are being made to the old.

Pennsylvania Guards Water-Works

When diplomatic relations with Germany were severed, Dr. Samuel G. Dixon, health commissioner of Pennsylvania, sent an order to every water plant in the state that a strict rule against admitting visitors was to be enforced. This action was taken purely as a precautionary measure and not, as was rumored about when the step became known to the public, as the result of information that certain water supplies were the objects of attempts at poisoning.

After war was declared, this work, especially in some of the larger places, was systematically taken up by other agencies, like the state constabulary, local police and private guards, and Dr. Dixon turned his attention to maintaining a supervision of the watersheds.

The department has a force of stream inspectors, whose duties in ordinary times are to examine water-supplies, abate nuisances and pollutions, etc. There are about 80 men constituting this force.

Under the law creating the Department of Health, the commissioner is clothed with authority along police lines. Therefore, he appointed these stream inspectors as constables. Revolvers were purchased and supplied to these men, each of whom was thoroughly examined by the department medical men, before he was armed, for possible physical defects that might make it unwise to intrust him with arms. The examination was rigid.

How To Keep a Construction Camp Clean and Sanitary

Rules Adopted for Alaskan Railway Work Have General Application on All Construction Jobs

THE sanitation of construction camps for the Alaskan railways is covered by rules recently adopted by the Alaskan Engineering Commission and put into effect on Apr. 1. They were drafted by C. C. Benedict, sanitary officer, and approved by F. Mears, commissioner. As the regulations are of general application, some extracts are given herewith.

It is directed that the camp must be located on the best site obtainable (consistent with convenience to the work) from the standpoint of water-supply, drainage and sewage disposal. Attention is called to the laws against pollution of streams, springs, wells, etc., and resident or district engineers are required to report any violation of these laws.

Water-Supply from Streams and Wells

When water-supply is taken from a stream, the intake must be above the camp site, and a sanitary survey must be made of the stream above the intake. If any source of pollution is found, it must be reported to the sanitary officer by the district engineer and a well dug to furnish water-supply. Wells must be at least 100 ft. from any cesspool, toilet or stable and must not be on ground receiving drainage from any such place. They must be covered, and must be curbed to a height of 1 ft. above ground where a pump is used, or 2½ ft. where a bucket with rope is used. Earth or gravel must be filled around the curb to a height of 12 in., sloping to the ground at a distance of 6 ft. in order that surface water may not get into the well.

Food Protection and Garbage Disposal

The mess, or dining, tent must be separated from the cook tent or kitchen by a door or fly that may be closed. The tables must be provided with cotton fly-screens, which will be kept spread except when tables are being used to serve meals. Suitable measures must be taken to keep mess tents as free from flies as possible.

The cook tent must be located on ground that is sloping or can be easily drained. The floor will be of dressed lumber, preferably tongue-and-groove flooring, made water-tight, if not water-tight the floor must be raised 12 in. above the surface of the ground, so as to permit free circulation of air underneath. The floor must be scrubbed daily and kept in a clean and sanitary condition. Fixtures and utensils must be so arranged as to permit free access for cleaning purposes. Work tables and other utensils must be kept free from accumulations of flour, dough, grease, etc.

Canned goods (excepting milk) must be emptied as soon as opened and not be permitted to stand in the original tin cans. A well-ventilated, properly screened fly-proof meathouse must be provided adjacent to the cook tent, for storing small quantities of fresh meat. Receipt of any fresh meat in bad condition must be reported at once to the district engineer, who will report it to the sanitary officer.

All garbage should be burned in the cook stove as completely as possible. Flyproof and water-tight cans must be provided for scraps, empty cans and waste material. These must be removed to a point remote from the camp, and the contents either buried or burned. Such removal should be made every second day from May to September inclusive, and once a week during other months. Throwing such garbage in streams is prohibited.

Care of Sleeping Quarters

Bunk or sleeping tents must be located not less than 200 ft. from stables or 100 ft. from toilets, and on ground that has natural drainage or can be readily drained. The floor must be kept in a clean and sanitary condition. Each bunk or tent house is to have an opening 16 x 24 in. in each gable, covered with metal fly-screen. The canvas removed from such opening may be left attached at the top, but must be kept rolled up so that the opening is not closed. Each Sunday all blankets in use on bunks are to be hung out of doors and thoroughly aired for not less than two hours.

No toilet may be located within 300 ft. of any stream, unless separated therefrom by a rise of ground that produces surface drainage away from the stream. A site of such topography should be selected if possible. The pit is to be at least 6 ft. deep, 4 x 2 ft., and covered by a tight floor banked around the edges so that it will exclude flies.

Fitted to an opening in the floor should be a flyproof box fitted with a board cover over the seat hole, which must also be flyproof. Such box should be easily detachable from the floor. The seat cover must be hinged at the back and made to be self-closing. A vent shaft, 4 x 4 in., should extend from below the floor to 12 in. above the roof. The superstructure for view shelter may be of canvas or wood, provided there are no openings in the floor, seat box or cover, where flies may enter. Such structure may be of the portable type. Whenever the toilet is moved or the camp discontinued, the pit is to be filled with earth flush with the surface of the ground.

Cesspool for Waste Water

A cesspool to receive waste water is to be provided and must be not less than 10 ft. from cook, mess or sleeping tent. It will be at least 8 ft. deep and 4 ft. square, covered with lumber 1 ft. from the top and backfilled with earth or gravel. It must be curbed with sound lumber or poles, with 2-in. spaces between boards for leaching purposes. A drain of lumber or 2-in. iron pipe leads from the sink to the cesspool and is buried 2 ft. underground. Or leading down through the cesspool cover there may be a chute 12 x 16 in. provided with a close-fitting cover on hinges.

All waste water must be placed in the cesspool, which is to be kept flyproof and in a clean and sanitary condition. Throwing waste water on the surface of the ground is not permitted. A 4-in. vent pipe extends from within the cesspool through the cover to a height of 10 ft. above the ground.

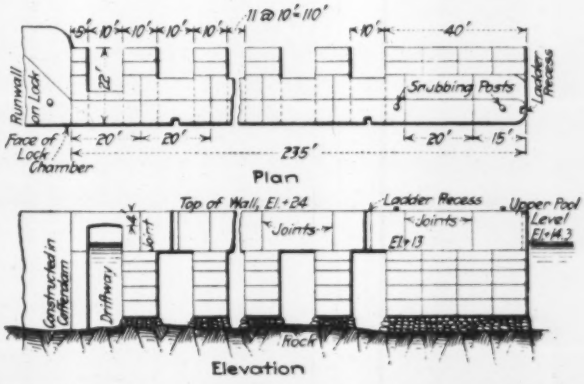
Buildings or tents for stabling horses must be located on ground freed from moss or sloping away from any well from which water is taken to be used for camp purposes, and not less than 200 ft. from such well and from mess, cook or sleeping tents. All solid excreta from the stable must be deposited daily in a flyproof box and be removed once a week, or placed in a pit dug for the purpose and covered daily with earth or gravel in such a manner as to exclude flies. Or the manure may be destroyed by burning. The method of disposal must be approved by the sanitary officer.

Throwing or dumping the manure in any stream is not permitted, nor must it be allowed to accumulate where flies may breed in it. Since flies develop from eggs to maturity in 10 days, it is necessary that manure be removed at intervals of one week to prevent their breeding therein. Wet or sloppy places in floors of stables must be filled with gravel at once. The entrance to the ground around the stable must be kept in a clean and sanitary condition.

Precast Concrete Cribs Used To Make Lock Guide Walls

Hudson River Lock at Troy Guarded by Mass Concrete Walls on Underwater Cribs and Precast Slabs

THE north guide wall of the Troy lock on the Hudson River, which was completed a short time ago by the forces of the local United States Engineer Office, utilized in a somewhat novel fashion the precast system of concrete construction both in the foundation cribs and in the base of the superstructure. The work is described in the current number of "Professional Memoirs" by John J. McCabe, junior engineer, United States Engineer Department, who was connected with the work.



GUIDE WALL OF TROY LOCK IS OF BUILT-UP PRECAST CONCRETE CRIBS

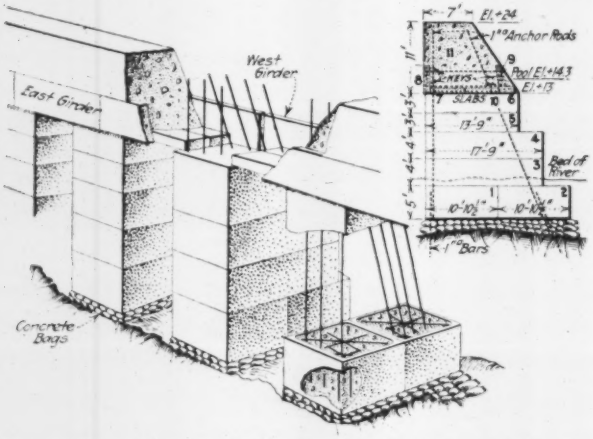
The guide wall, as here shown, is 235 ft. long and consists of a continuous upper wall extending down below water level and resting on a series of piers. These piers are built of precast concrete cribs.

Why Precast Cribs Were Used

Crib construction was used because of the better concrete that could be obtained by air placing and because of the facility of placing on the irregular rock footing, which would have had to be laid dry by a cofferdam in order to insure a perfect placing of mass concrete. A cofferdam for so small a piece of work was considered too expensive, so a concrete-crib construction footing on diver-placed sacks of concrete was substituted.

The cribs, shown below, were of variable size to accommodate the stepped face of the wall. They were designed to have a width equal to that of the piers and to be strong enough to resist the pressure of concrete poured into them after having been cast seven days, yet light enough to be handled by the plant on the work. This latter point necessitated a small size of crib with very thin walls, with ample reinforcement, which included diagonal and lateral cross-rods bracing the wall. These rods proved troublesome while filling the cribs with concrete, as they interfered with the placing of the tremie and very often fouled it when it was necessary to lower it quickly to prevent loss of the charge.

The cribs stopped at an elevation below that of the upper pool, which required that the forms for the superstructure be set in at least 2½ ft. of water. As there



HOW THE CONCRETE CRIBS FOR THE TROY GUIDE WALL WERE LAID UP

was possibility of getting washed concrete at the faces when pool level was above normal and also as placing below water of the floor forms bridging the opening between the piers would very likely be slow and troublesome, it was decided to bridge that opening up to elevation 2 ft. above pool level with precast reinforced-concrete girders for the faces and with slabs for the floors, these being keyed into the concrete placed above the slabs. The superstructure was then continued with the usual forms, lapping the girders and extending to the top of the wall.

The cribs, girders and slabs were built on the bank about opposite the wall site, using aggregate discharged by a dredge there, which proved very satisfactory. Concrete was mixed and placed by hand, and practically all the casting was finished before placing was started.

The rock surface was prepared by blasting and cleaning, and the surface was leveled off to receive each crib by concrete placed by a diver on the lines of the crib walls according to the method described in the "Hints to the Contractor" section of this issue. The lower cribs were then placed, using another type of guide frame by a diver; drill holes were made into the rock bottom through the openings, and the stub anchor rods were placed and grouted in by means of a closed tube reaching well up above the water. After these anchors were in place, the upper cribs were set, the interior reinforcing rods were tied to the anchor rods, and the cribs were filled with concrete through a tremie.

When the cribs were filled, a derrick boat set the girders and slabs. The girders were lined by a transit from the lock wall and were held in position by two rows of short rods placed in holes provided in the girders and joined by long rods between, with a sleeve joint just inside the girders, allowing the short rods to be removed after the concrete had set. At the top of these rods were placed 4 x 4-in. struts cut the correct distance between the insides of the girders and removed as the concrete was brought up to them. Concrete was next filled in between the girders and the forms for the remainder of the superstructure set on timbers bolted to the girders a little below the top, using the before noted short rods through the girders.

Construction Company Speeds Work on Marine-Corps Camp

Great Variety of Operations Necessary in Preparing Site and Putting Up Buildings at Quantico, Va.

A CAMP for the training of marines is in progress of construction by the George A. Fuller Co., under contract with the Bureau of Yards and Docks, Navy Department, at Quantico, Va. Clearing of the land by burning and cutting off the timber and by dynamiting of the stumps, the making of accurate topographical surveys of the 5000-acre tract—this by the contractor—the construction of roads, railroad spur tracks and bridges and the erection of buildings, the installation of distribution systems for water, sewer and electricity and the development of a water-supply from an artesian well, sewage disposal and electric plant are all going on coincidently and with only short time intervals between one operation and its next successor.

Orders for the construction of the camp were received by the Fuller company on May 2. On May 7, men and materials were on the ground, and work was started. Progress to May 22 is shown by the accompanying pictures.

The camp, which is at present intended to accommodate 5400 men, but which will probably be extended to care for twice that number, is located on the banks of the Potomac River on the Richmond, Fredericksburg & Potomac R.R. (the Washington Southern to this point) 35 miles south of Washington, D. C. The camp is being prepared to meet the immediate needs of 27 companies of about 200 men each. To each company six buildings are assigned—four barracks, one mess hall and a latrine. In addition, there will be general administration buildings, officers' quarters, storehouses, bakery, garage, stables and hangars.

The Fuller company is represented on the ground by J. G. Bent, general superintendent; J. Berrall is engineer in charge of the field and construction work for the company, and he has as his assistants 10 engineers who were graduated early from the College of Engineering of the University of Michigan for this express purpose. Maj. Seth Williams, assistant quartermaster, United States Marine Corps, is construction quartermaster. Lieut. T. J. Holland, of the Marine Corps, is his assistant on the ground. Maj. Chandler Campbell is commanding officer of the camp.

Engineers Must Coöperate for Recognition and Service

From an Address Delivered at the Third Annual Convention of the American Association of Engineers, Chicago, May 14

By GARDNER S. WILLIAMS

Consulting Engineer, Ann Arbor, Mich.

TO ONE who reviews the status of engineering in America today, it presents a somewhat anomalous aspect. Owing to the wide differences in technical standing of those who are its devotees, it appears at one glance a profession and at another a trade. At one end of the list are some thirty thousand members of the national engineering societies, which represent the elite, the aristocracy. Next them stand the membership of the state and local societies and the water-works associations, which add probably sixty thousand more; and back of and beyond these are the draftsmen, instrumentmen, inspectors, chainmen and rodmen, probably at least a hundred thousand.

On account of this varied make-up, engineering appears in a markedly different situation from the law, medicine or the clergy. Among these three learned professions, it is rarely indeed that a member in the lower ranks is employed by any but a member of his own profession, and however employed, the professional independence of the employee is rarely transgressed: but in engineering it is relatively few who are masters of their own performances, and many of them are directly employed by and report to men who are not themselves engineers and who therefore take little interest in the advancement of engineering.

This condition of affairs militates strongly against that solidarity which is essential to such a recognition of the engineer as the importance of his work would warrant. The young engineer oftentimes feels nothing in common with those higher up in the profession, beyond the fact that both he and his superiors for several grades above him are working on salaries for the same employers, in whose estimation engineers are probably merely instruments of service to be taken up or laid aside as business exigency or individual caprice may dictate. In spite, however, of these handicaps the recognition of the engineers has steadily increased, though not so rapidly as we would wish.

Accelerating Recognition of Engineers

What can we do to accelerate that recognition to which we believe the engineer entitled? For answer we must inquire whence is the recognition to come. If it be from the general public, then it is a question of advertising; if it be from the governing bodies of our municipalities and states, then it is a question of votes.

In the past, engineers have sought only the recognition of the few who by their own attainments were qualified to judge the merits of the work of their fellows without the intervention of an advocate. The assistant has been content with the approval of his chief, and the chief with the approval of his fellow engineers. It is seldom that the public has been taken into confidence.

The man who conceives, who dreams the dream, is of vastly more importance and value to the world than he who merely makes it a reality. It is ideas that are needed—there are plenty who are ready to execute them. So the greatest in engineering are the designers, those who conceive and produce that which has not been conceived or produced before.

The time has come when recognition must be given both to the dreamer and to the builder. Those who have made possible the present condition of human existence, upon whom the world depends for its morning meal and its evening light, for its daily news and its weekly bath, are entitled to the acknowledgment of the debt their fellows owe, and they must get it. The answer to the query *How?* is in the one word *Coöperation.*

When, a decade ago, arrangements were completed by which three great national engineering societies were brought together under one roof, the first great step in engineering coöperation was taken; and when, after ten years of "watchful waiting," the parent society of them all has joined its offspring, coöperation in engineering may well be looked upon as established. But the national societies, although they include in their membership several thousand young engineers, nevertheless represent the aristocracy of the profession and never in any way reach or supply the needs of those who make up the vast numbers dependent upon engineering for their livelihoods, but who have not yet reached that condition where they can maintain themselves by independent effort.

Like all aristocracies, the national societies are conservative. Being composed of or at least controlled by those who have achieved their successes under existing conditions they naturally hesitate at any wide departure from past custom and experience. Furthermore, they are not closely in touch with those who may be said to compose the rank and file of their profession, and therefore do not know to what extent the latter will support such efforts as they may make.

A Model of Society Coöperation

The American Medical Society has built up the most complete and best-organized system of coöperation yet developed in this country. Starting with the county medical society as the unit, to which every practitioner in the county is supposed to belong, there next comes the state medical society, to which the county societies send representatives, and this in turn sends its delegates to the American Medical Society. The process is simple, the attainment complete. Every physician in the country is thus within call of the head of the organization in the national society. The Chamber of Commerce of the United States has accomplished a similar purpose with the local business organizations without the intervention of the state society. The Bankers Association follows the plan of the physicians.

For the engineer, inasmuch as the state societies are rarely as strong as some of the local societies within the same territory, it does not seem necessary to go from the local to the national organization by way of the state society as an intermediary, but more rational to unite all national, state and local societies in a combination, to

the governing body of which each would send delegates in proportion to its membership.

The national societies have in embryo an organization well adapted to this purpose in the Engineering Council, and if they can be brought to see the advantages to come from an extension of it beyond the limits of their own membership, there should be little difficulty in gathering into the combination the ninety thousand more or less engineers now affiliated with the national, state and local societies, and we would then come to that great army of more than equal size which until recently was wholly unorganized and among whom the American Association of Engineers has its greatest field. This organization, in which I am proud to be recorded a member, stands before you as the embodiment of the democracy of engineering, with a representation in every state and important city in the union, and a membership of eighteen hundred and fifty acquired in less than two years of existence.

The American Association of Engineers announces as its objects: "To raise the standard of ethics of the engineering profession and to promote the economic and social welfare of engineers," and in pursuance of these principles has sounded the watchword of coöperation. It has begun by making itself useful to those most in need of its assistance and has gathered to its standard a membership largely composed of those whose names are unknown to the rosters of other societies and has laid a foundation large enough and broad enough for every engineer to stand upon if needed.

But we should look to the national societies to take their place as leaders in bringing about complete cooperation of engineers. The charge has been made that the proposed Engineering Council is undemocratic, but no one can say it is unrepublican. In a body so large as the national societies, and so large as this society will soon become, government by conventions will be a failure; it must be intrusted to representatives; and in order that each member may have a voice, the elections of those representatives must be by letter ballot.

If the national societies fail to meet their responsibilities, if after a reasonable time they do not work out a plan of coöperation involving the utilization of all engineering forces of this commonwealth, then it will be time to turn to other agencies; and the possibilities of this association will be entitled to the most serious consideration.

Personal Service to Public the Motto

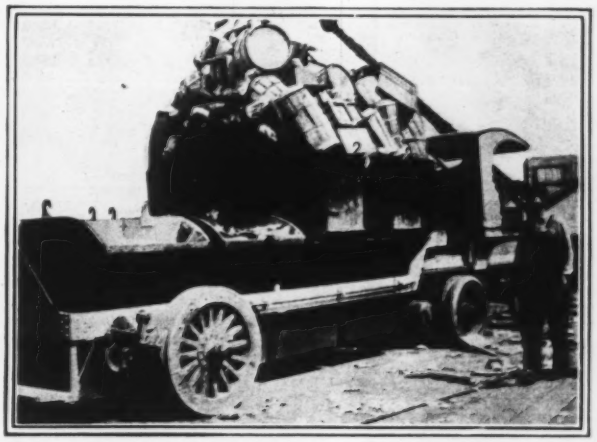
The American Association of Engineers is not a trade union. While it contemplates rendering actual service to its individual members, it also contemplates and insists that its members shall render service to it, and to each other. For him whose only query is, "What do I get out of it?" there is but scant place; but for him who asks, "What can I do to assist my fellow engineers?" the doors are wide open.

What can you do? You can make yourself an influence in your community. Your education entitles you to be a leader of thought among your fellows. Your training teaches you accuracy of mind and body and enables you to analyze propositions and deduce correct conclusions. Your place is in every public assembly, at your party caucus, and at your country's polls on election day. Establish and maintain local organizations, if only in your ward, to bring together the engineers for the purpose of discussing the questions of the day—not merely engineering questions, but every question which agitates or interests the citizenship—and when you have come to a conclusion to which you are ready to subscribe, go out and fight for it before the public, in your caucus and at the polls, and let the people know that you are one of two hundred thousand of the best-trained, most capable citizens of the republic, who is doing his duty by his fellowmen, by his profession and by himself.

Motor Vehicles the Key to N. Y. Street-Cleaning Problem

Commissioner Fetherston, in Annual Report, Tells of Progress Made by Department in 1916

IMPROVED equipment, involving the partial replacement of horses and carts by motor-driven vehicles, was responsible in large measure for the results accomplished by the New York City Department of Street Cleaning during the year 1916. Commissioner John T. Fetherston, who has directed the department's work for the last three years, made public, this week, a report on the progress up to Jan. 1, 1917. Averaging results for the last three years and comparing them with those of the preceding three years indicates that the cost of service has been reduced 26c. per capita, in spite of the fact that the wages of labor have advanced considerably of late. The following extracts are from the report:



ON THE BIG TRACTOR-TRUCKS SEPARATE CONTAINERS ARE PROVIDED FOR ASHES, GARBAGE AND REFUSE

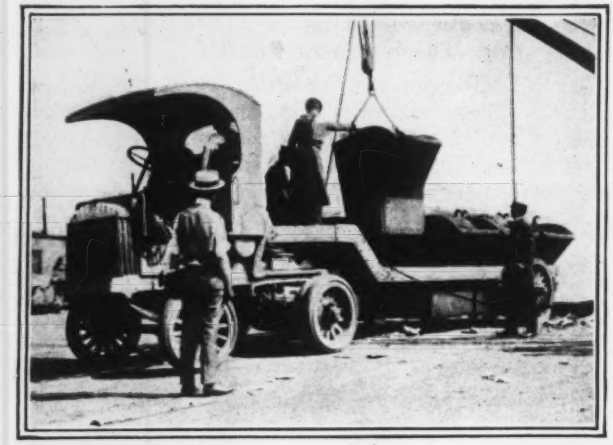
The Physical Problem

The New York Department of Street Cleaning serves a resident population in excess of five millions and a fluctuating transient population averaging close to another million. In the three boroughs of Manhattan, the Bronx and Brooklyn, which are under the jurisdiction of the Department of Street Cleaning, there is an area of 140.2 sq. miles, and there are 302,294 buildings—an increase since 1915 of 5540 buildings. The maximum density of population per acre in the most thickly populated ward (lower east side of Manhattan) is 696.7; minimum density (outlying Brooklyn) is 3.2; average density for the three boroughs, 78.1. In the three boroughs there were 101,723 horses and 89,122 automobiles, commercial and

pleasure, in 1916. The increase in the number of automobiles over 1915 was 26,217, or more than 40% in one year. There was an increase of 37% over 1915 in the number of commercial motor vehicles in the city.

Model District

The most far-reaching feature in the program of equipment improvement was embodied in the plans for the Model District. In the belief that the time had arrived when the department should discard its antiquated equipment and adopt modern, up-to-date machinery, the Board of Estimate and Apportionment was asked to provide the funds with which a beginning could be made. The sum



THE UNIT CONTAINERS ARE EASILY REMOVED BY TACKLE FROM A DERRICK BOOM

of $250,000 was appropriated for this purpose, and District 6, Manhattan, was selected as the field in which to work out the new plans.

Adoption of Motor Power

The first step taken in remodeling the district was to devise plans and apparatus operated by motor power to displace the horse-drawn vehicles and cleaning by hand, so far as practicable. After thoroughly investigating and testing all available apparatus supposedly suitable to the purposes in view and finding none entirely satisfactory, the engineering division of the department undertook the task of designing the principal pieces of apparatus required for the economical working out of the newly devised methods. A gasoline-electric tractor was designed by the department's engineering division and after construction and trial was found to meet requirements. During 1915 twelve of these tractors were completed and made ready for service at a cost of $4166 each. Trailers, to be drawn by the tractors and combining facilities for collecting in separate compartments ashes, street sweepings, garbage and rubbish, were also designed and constructed. These trailers provide for the collection of the four classes of material on the same trip, whereas the old horse-drawn cart requires three distinct trips for the task. In addition to this apparent economy, each trailer carries an amount of waste material equal to eight cartloads. Eleven of the trailers were constructed during 1915 at a cost of $810 each.

During 1916 seven additional tractors and six trailers were added to the Model District equipment, and of those constructed in 1915 two tractors were transferred to Brooklyn and one to the Bronx, leaving sixteen tractors and eighteen trailers for Model District service.

Combination Flusher-Sweeper

Further motorization of the Model District equipment was accomplished in 1916 by the installation late in the year of a combination flusher-sweeper, which was also designed by the department's engineering division. This machine, as its name indicates, flushes and sweeps the street pavement in one operation, thus not only enhancing the quality of those branches of the service, but doing so economically. Three more of these combination machines are in course of construction and will be ready for use when weather conditions will permit flushing. Other equipment in the Model District has been made to conform to the motorized collection methods, by the installation of locomotive cranes, for transferring trailer loads to scows, and by advancing all contingent apparatus and methods to the higher plane.

Approximately $68,000 was saved to the city by this modern equipment in 1916, as compared with 1914, the last year in which horses exclusively were used for collection in the district.

To Motorize Other Districts

The Model District, Commissioner Fetherston states, has fulfilled the promises made for it. Though it is not yet complete in all its details, it has progressed sufficiently to prove beyond all doubt that motorized equipment and the accompanying improved methods produce enhanced service at reduced cost. Accepting this testimony as a guide, the Board of Estimate and Apportionment has provided, in the budget for 1917, for the motorization of two more districts, Nos. 9 and 11 in Manhattan, and for motor-flushing machines in Brooklyn and the Bronx. For the former purpose the sum of $485,500 has been provided. Brooklyn is to have ten and the Bronx two flushing machines, for which the sum of $108,000 has been allowed in 1917.

Increase in Flushing

Extension of street flushing has been a cardinal feature of the present administration's program since taking office. During 1914 advance in this direction was slow, as the plans for the year were made during the fall of 1913 and further, as there was only a limited amount of water and hose available for the purpose. In 1915, after a careful study of the subject in coöperation with the engineers of the Water Department, the methods employed were markedly improved and along scientific lines. The amount of flushing was increased 30% over 1914. Improvement in the manner of handling and caring for the hose, with coincident training of the men, resulted in better service and economy in the use of water and equipment. A standard practice was installed, and the men were carefully drilled in the best methods of performing the work.

In 1916 still further improvements in flushing were made. The hose gangs were increased to 200; and so far as funds would permit, greater and improved equipment was supplied. During the year, increase in the area flushed and washed was extended until, in the summer and fall months, practically every street in Manhattan, and most of the important or congested thoroughfares in

Brooklyn and the Bronx, were cared for by hose, squeegees or sprinkling carts and machine sweepers at least once in every 24 hours.

As has already been stated, a combination flusher and sweeper, which will greatly facilitate the work of street washing, has been constructed under department designs. It is intended to have from 15 to 20 of these machines ready for the service during the coming summer.

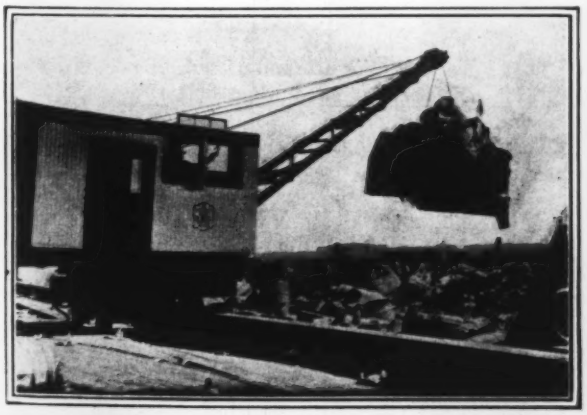
The Labor Force

Never, since the organization of the department has the problem of securing and retaining a sufficient force of competent labor been so difficult as during the year 1916. Not only has this been true in the matter of emergency men for snow work, but also of the regular force of drivers and sweepers. Obviously, this condition has resulted from the abnormal demand for labor in practically every field of industry. So great has been this pressure upon the department's supply of labor that during the last six months of 1916 there was an average shortage of drivers and sweepers approximating 500 men, or about 8% of the normal complement. Notwithstanding extraordinary recruiting methods employed by the department and the Civil Service Commission, it was not possible to secure a sufficient number of new men to fill the vacancies due to retirements from the service. Civil Service lists were completely exhausted.

Wage Advance and Adjustments

On Jan. 1, 1916, a merit system of apportioning wages in the various classes was put into effect. Regular drivers, who had formerly received a flat rate of $800 a year, were placed in five grades, the wages ranging from $768 to $864. Regular sweepers, whose old rate was $780, were graded from $720 to $792. Extra drivers were advanced from $2 to $2.40 per day, and extra sweepers from $2 to $2.30 per day. The schedules for hostlers, stablemen and dump boardmen were also readjusted on lines of the merit system, with increased compensation for the higher grades.

Schedules for 1917 comprehend advances that will give the following wages for first-grade men: Regular drivers, $888 per year; extra drivers, $2.60 per day; regular sweepers, $816 per year; extra sweepers, $2.50 per day; hostlers, $840 per year; stablemen, $840 per year; dump boardmen, $840 per year; automobile drivers, $924 per year; and trailer loaders, $840 and $864 per year.



THE RUBBISH CONTAINER FROM THE MOTOR TRUCK IS PICKED OFF BY A LOCOMOTIVE CRANE

THIS ELECTRIC TRACTOR RELAYS GARBAGE COLLECTED BY CARTS TO WATERFRONT DUMPS

Inspired by the conviction that the quality of the service rendered by the individual employee would be greatly improved if each was carefully instructed and trained in the work assigned to him, a campaign of education was determined upon. It was decided that the first step in carrying out this plan should necessarily be a thorough inquiry into the methods employed theretofore, with a view to the elimination of the inefficient and wasteful; this to be followed by the strengthening and standardization of the efficient.

In undertaking this work the head of the department took counsel from every available source having the support of scientific knowledge of the problems to be dealt with and from those whose practical experience made valuable their suggestions and opinions. The matured thought of the engineer was then brought into contact with the actual experience of men who had gained their knowledge and formed their opinions in the field of the department's operation.

Standard Methods Adopted

Field officers, some of whom had been in the service twenty or more years, were called into conference with the head of the department and his engineers, and a thorough analysis of past methods in this city and elsewhere (as far as possible), together with new and advanced thought, was had. The tangible result of these conferences was the adoption of standard methods for the performance of the several branches of the work. A series of booklets, clearly setting forth in detail the approved method to be employed in the performance of each phase of the work, was printed, and each responsible officer of the department was supplied with a complete set of the booklets, with instructions to observe strictly the rules laid down.

The result of this procedure was to fix uniform methods throughout the territory under the jurisdiction of the department. All districts are now striving to reach the common plane of performing the same work in the same way, giving the service the benefit of the best acceptable methods of each district, fortified by new and approved features and discarding the inefficient and time-wasting.

To secure the best results of this standardization, it was apparent that, not only should the officers be instructed and drilled, but that the men under them should be trained. Right there was found the most difficult factor in developing the new system. Sweepers, drivers and other workers who have become accustomed to generally following their several respective ways of doing things—frequently starting wrong and never getting right—have much to unlearn before they become amenable to new teaching. "It's difficult to teach an old dog new tricks." While it is the policy of the administration to insist that the officers require observance of the methods set forth in the books of rules, it is understood that there are habit-formed obstructions to adaptability.

A School of Instruction

To assist in solving this difficulty and to provide for its gradual removal, a school of instruction was established, in which all recruits are given a practical education in their duties and in the methods of performing work. Men who have passed the Civil Service examination and have been recommended for the sweeping, driving or other uniformed division of the force, are given courses of instruction in the school before being assigned to regular positions. Competent instructors are in charge of the classes, and using the above-mentioned books of rules as textbooks and in simplified manner making perfectly plain every detail of approvad methods of performing the work, they instill into the minds of the beginners correct principles and train their hands to the most efficient application of those principles. The school also inculcates in the minds of new city employees their responsibility as temporary custodians of city property, in the form of tools and machines, and impresses upon them their obligation to properly conserve such property.

During the seven months that the school of instruction has been in existence it has trained and turned out for active service 183 sweepers, 148 drivers, 30 chauffeurs (20 of whom are tractor drivers) and one craneman. Special courses of instruction have also been given to 340 officers of the department during the same period.

It is believed that, because of the training given the men who are newly recruited for the service, there will be a constant and perceptible improvement in the quality of the work performed by the individual worker. This, in conjunction with an established system for the whole department and officers trained to uniformly direct the work along lines of greatest efficiency, will inevitably produce results gratifying to the public and the department.

Oil-Wastes Storage Reservoir

The Standard Oil Co., of Kansas, has completed a reservoir 11 acres in area and 8 ft. deep, at Neodesha, to store wastes from agitators over periods of low flow in the Verdigris River. These wastes cause vegetable odor and taste in the water-supplies of Cherryvale, Independence and Coffeyville, Kan., taken from the river from 8 to 30 miles below the refinery. For three years these wastes have caused trouble. A plant for deordorizing the wastes by heating them with water from condensers and by aëration was tried, but failed because a temperature higher than could be furnished by the condenser water was necessary.

Seven-Day Sand Tests No Criterion for Six-Month Tests

Sand Proved Unacceptable with Different Brands of Cement in Short-Time Tests—Passes Tests at End of Half Year

By L. R. BROWN

Assistant Engineer, New York Railway Co., Rochester, N. Y.

ON A RECENT large construction job a large quantity of sand had been purchased and delivered and the cement contracted for to be delivered in carload lots as needed. The cement was required to pass the standard tests and each carload was sampled and tested in the company's laboratory, but no tests were made of the sand except perhaps a so-called "inspection" by the engineer in charge. The sand was obtained by dredging the bottom of a lake.

The work had been going on for some time when workmen's comments on "the poor quality of that last lot of sand" led the writer to take a sample of the sand and to have briquettes made up using a 1:3 mixture of cement and sand. At the same time another set of briquettes was made of a 1:3 mixture using the same cement but sand taken from a lot obtained previously. The results are given in the table; the values given being the tensile strength in pounds per square inch and the average of twelve briquettes.

	7-Day Test	28-Day Test
"Poor" sand we were testing	37	100
Sand obtained previously	78	206

The results of the 7-day test were so unfavorable to the sand that we at once ceased using it and obtained sand from other sources until we could experiment further. The 28-day test given above also showed up the poor quality of the sand in question as compared with other sand.

Previous Experience with Sand Tests

At this time the writer came across the articles in *Engineering News*, May 30, 1912, entitled "A Proposed Study of Concrete Sands." In one of these articles the following conclusions were drawn, by the author, John R. Freeman:

"That a given untried deposit of sand should never be relied upon or used in important work, until after at least a *7-day test* with the particular brands of cements which are to be used.

"That some well known brand of cement may give success with this peculiar sand when half a dozen equally good brands fail utterly.

"That this mysterious defect in the sand possibly or probably can be cured by the addition of some exceedingly minute quantity or form of alkali (or anti-colloid) to the cement, which alkali or unknown "*x*" is so inconspicuous by reason of its composition or quantity that the ordinary commercial chemical analysis of cement does not detect it."

The articles further stated that the poor quality of sand obtained from lake bottoms was sometimes due to chemical deposits or films on the surface of the grains of sand and because of the differences in the chemical properties of portland cement it had been found possible by experimenting with various brands of cement to find

one so chemically constituted that it would neutralize the injurious properties of the sand and so produce stronger mortars with the sand in question than other cements would.

Different Sands and Cements Tested

Acting on this suggestion two other brands of cement (all that could be procured locally at the time) and a third kind of sand were at once procured. The sand was a bank sand in common use locally and known to be a good concrete sand. Nine lots of briquettes were then made up by combining each brand of cement with each kind of sand in 1:3 mortars. There were twelve briquettes in each lot and of these four were broken at seven days, four at twenty-eight days, and four at six months.

In these briquettes the amount of water used was that sufficient to give "normal consistency" as generally understood, that is, the mortar was made just moist enough so that a film of water would form on the surface when patted or rubbed for a moment with a trowel. The exact amount of water was not noted, but the different sands required different percentages. Great care was taken to produce uniform results. The results of these tests are given in the accompanying table. For simplification the brand of cement being used on construction is called "A" and the others "B" and "C". The sand being used on construction is called "X"; the sand from the previous lot is called "Y" and the bank sand last obtained is called "Z".

"X" Sand	7 Days	28 Days	6 Months
A Cement	66	205	394
B Cement	128	256	281
C Cement	94	185	288
"Y" Sand			
A Cement	143	195	454
B Cement	158	252	405
C Cement	156	223	388
"Z" Sand			
A Cement	228	272	468
B Cement	187	291	419
C Cement	214	293	511

In the above table the results of the 7-day tests show at once that both the cements B and C produce higher values with sand X than does cement A. The value of XA combination in the above table is higher than the same combination in the preliminary tests because a different carload of the A cement was used. This same increase shows up in the YA values. The higher 7-day values of the BX and CX combinations might have been due to the fact that the B and C cements were stronger or had quicker setting properties, but this was not the case as is shown by the 7-day results of their combination with the Z sand, which is known to be free from the film said to be on the lake sand. The ZA value is higher than either the ZB or the ZC values. This shows the purpose and value of having used this Z sand in these tests.

From these 7-day results it seemed quite evident that we had found a cement B which gave much better results with our sand X than the cement C which we were using. We therefore ordered enough of the brand B cement to use up the X sand we had in stock. One lesson at least was learned by this experiment: this was to make actual tests of sand as well as of cements before buying.

Because of the haste necessary in conducting these tests in order not to delay the construction work, conclusions were based on the 7-day tests. The 28-day test is considered more reliable and the longest required by the standard tests. An examination of the values of the 28-day results in this case shows we would have reached the same conclusion if we had waited for these results.

Now comes the surprise. Examine the six-month results. These give the AX over 100 lb. per sq.in. in excess of the BX or CX values which is opposite from the results of the 7-day and 28-day tests and nearly as high as the values found with the better sands.

The conclusion I reached is that probably the values of combinations of lake sand and cement found in the 7-day and 28-day tests are influenced by properties in the sand that hasten or retard the setting of the cement. Thus a comparatively high value resulting from a mixture of sand and cement may be due to chemical action produced by the combination of certain chemicals in each that hastens the setting of the mortar, rather than to a neutralization of the injurious substances in the sand by the chemicals in the cement. In our case, I think, the chemical combination produced by the AX mixture delayed the setting of the mortar, but when the final strength was attained at the end of six months it was even stronger than other mortars made with other cements and the same sand.

Conclusions

Briefly the results of the experiments are as follows:

1. Nearly all well graded sand has proved reliable on a six-month test.

2. The reason for my low values of 7-day and 28-day tests is due to a delay in setting because of chemical properties in sand or cement.

3. While changing the brand of cement used with a given sand may give higher values for 7 days and 28 days, the six-month results may be lower.

4. The addition of small quantities of alkali to the mortar probably has only the effect of hastening the hardening of the mortar.

Pump Efficiencies Depend on Service Period

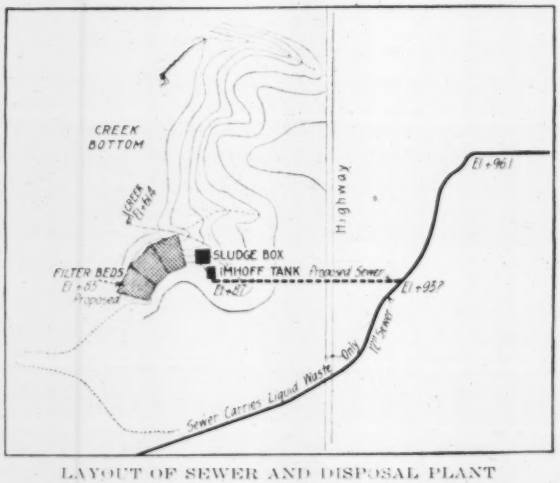
In regular service, the duties of various pumps in the Metropolitan Water District of Massachusetts are computed weekly on the coal basis and are therefore records of plant efficiency. Where conditions are such that the engines can run at the rated capacity of 24-hour service, the results compare favorably with those obtained at duty trials; but where the engines are not run continuously, or operate below the rated capacity, or, as frequently happens, are subjected to both these handicaps, the duty is seriously affected and may be only from 50 to 75% of the trial duty, depending on conditions. The engines at the small pumping stations, and the low-service pumping engines, according to a statement made by A. O. Doane, division engineer, in a paper presented to the American Waterworks Association, are particularly subject to these unfavorable conditions. The efficiency of the boiler plants is satisfactory. All the larger boilers are of the internally fired fire-tube type, and as the load is steady while the engines are running, and the boilers have ample heating surface for the work, little heat goes to waste. Carefully conducted boiler tests have shown that the Belpaire boiler has a combined efficiency of boiler, furnace and grate of 80.3% and the Dean vertical boilers of 80.4%.

Build Wood Training-Camp City for 5000 Officers in Three Weeks

Buildings, Water-Supply and Sewerage System Constructed Principally by Day Labor Under Quartermaster's Direction at Fort Benjamin Harrison, Indiana—Experts Advise on Sewage Treatment—Motor Trucks Figure in the Delivery of Timber

THE housing of 5000 embryo officers in the training camp at Fort Benjamin Harrison, Ind., has been accomplished in approximately three weeks' time, the work being done by force account under the direction of the quartermaster, Major McCaskey. A few contracts have been let, for such things as electric lights and telephones, to the various utilities, but the major portion of the work that now houses completely the eighth and ninth officers' training-camp divisions was handled by day labor. Lumber was purchased in Indianapolis and rushed to the site by rail and by motor truck over a good macadam road leading to the fort. The road has been badly cut up by reason of the enormous traffic and is sadly in need of repair already. What it will be when the city to house 60,000 drafted men who will be trained here is completed, can be imagined.

For housing the Medical Corps reserve officers and three brigades of infantry in another part of the 3300-acre reservation, the Gaylord Construction Co., of Scranton, Penn., has the contract. Its methods of procedure



LAYOUT OF SEWER AND DISPOSAL PLANT

by successive gangs are similar to those used at Fort Myer, described in *Engineering News-Record* of May 17, p. 352. Laborers for this contractor and for the quartermaster have materially affected the unusual amount of construction work in Indianapolis, which includes several miles of paving, elaborate river-protection improvements at the Washington St. pumping station, nine canal bridges, 56 miles of railroad track in the Hawthorne yard of the Pennsylvania, $1,000,000 Van Camp factory and $500,000 Diamond Chain factory.

With each officer training camp division at Fort Benjamin Harrison is a company of engineers with Lieut. Col. George M. Hoffman, Corps of Engineers, U. S. A., commanding; Capt. A. K. B. Lyman and First Lieut. C. P. Cronkhite, both of the Corps of Engineers, are in command respectively of the two companies. When the engineers arrived on May 8, their cantonments were not complete; and many of the men were used immediately to assist the quartermaster in directing his day-labor forces, in staking out work, in bossing labor gangs, laying sewer pipe and in assisting the carpenters in finishing the engineers' cantonments. In the meanwhile they were quartered in the barracks at the fort. For the first month the engineers will get the same training as the infantry; then they will be transferred to Fort Leavenworth, Kan., where is located plenty of engineers' equipment. They will have there also cavalry practice. Class A and Class B reserve officers are taking the same courses.

Camp Arrangement

The topography is such that most of the area drains well, but is sufficiently flat to permit drilling anywhere. The cantonments for each division are placed facing a division street, practically according to army regulations and with sufficient space between the buildings to eliminate the spread of fire from one to the other. The engineers are located at one end, two buildings for each company of 150 men. This requires a structure 150 ft. long, of the regulation 20-ft. width. Back of each two buildings is a single mess hall, and a kitchen is still farther in the rear. The latter is equipped with the regulation field stove, a large refrigerator and another luxury in the shape of a sink, which the sewer system makes possible.

Water-Supply from Wells

For water the permanent fort supply was drawn upon. This is obtained from six 8-in. wells driven to depths varying from 500 to 900 ft., which are capable of yielding 700,000 gal. per day. Air lifts raise the water to a large steel tank with the water line 125 ft. above ground level. This source will be wholly inadequate to supply the 60,000 draft camp, which it is estimated should have a 3,000,000-gal. supply. Colonel Glenn and the officers of his staff from the Quartermaster, Engineer and Medical Corps, have canvassed the situation with C. H. Hurd, consulting engineer and formerly chief engineer of the Indianapolis Water Co. A well-drilling outfit is now opening a new well, but Mr. Hurd is of the opinion that

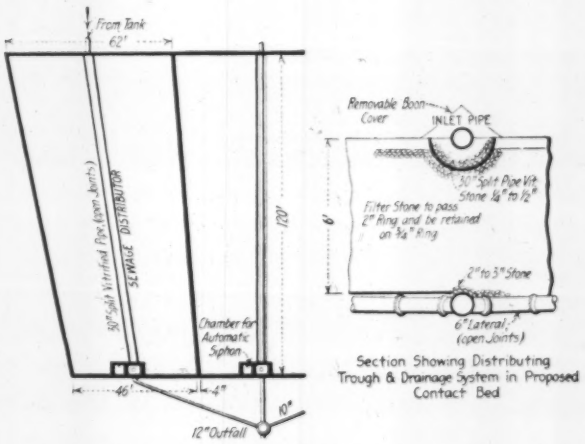
the chances of getting an adequate well supply in time—three months—are rather slim. He suggests a low dam in Fall Creek, a concentrically baffled circular coagulating and settling basin of about 750,000-gal. capacity, possibly wooden tub filters and a chlorine sterilizing outfit. The latter has been ordered.

Fall Creek, a practically unpolluted stream fed from springs, has a flow greater than the maximum requirements, so that a simple rock-fill dam sufficient to submerge the intake will answer. This should preferably be located about two miles above camp, to avoid local pollution. Turbidity from farm drainage after rains can be handled, Mr. Hurd states, by a liberal dosing with alum. Appropriations for an additional water-supply are not available to the officers in charge at the fort, so the business organizations in Indianapolis, seeing the seriousness of the situation, are assisting the officers by direct appeal to Secretary Baker. Even if work is started at once, there is barely time to get the reservoir constructed, the pumping equipment installed and pipe laid. A dual system may be installed if wells are used.

Another alternative consisting of an 8-mile main from Indianapolis, with booster stations en route, has been proposed, but the water-company officials hardly feel this is feasible on account of the difficulty of obtaining pipe.

Design Sewage-Disposal Plant in Two Days

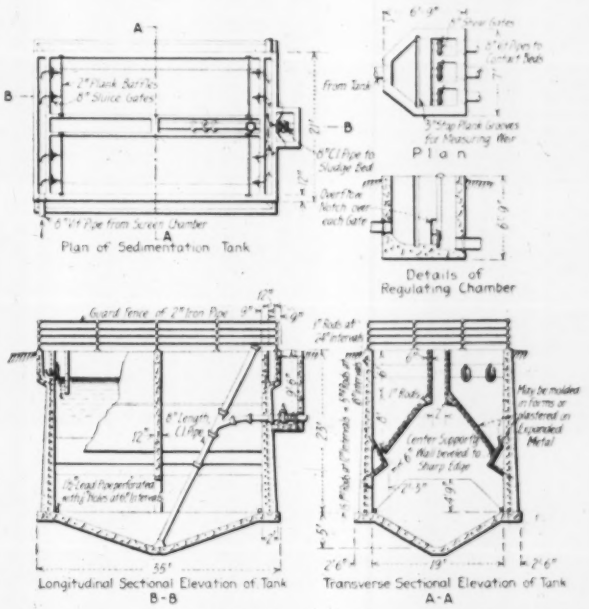
Pending the construction of a disposal plant, only liquid wastes are permitted to enter the sewers that drain the latrines, lavatories, cement-floored shower baths and kitchen sinks. Garbage and material from the dry closets are burned each day in the permanent crematory of the fort. Soon after the arrival of the engineers for the officers' training camp, Capt. Paul Hansen, chief engineer Illinois State Board of Health, and Capt. A. P. Melton, consulting engineer, Gary, Ind., under the personal direction of Lieut. Col. Hoffman, were detailed to design a plant capable of handling a population of 5000. Urgency required that the plans be completed in two days. First Lieut. G. C. Graeter traced and checked the five drawings.



Section Showing Distributing Trough & Drainage System in Proposed Contact Bed

DETAILS OF THE CONTACT BEDS

From experience in Texas, 15 gal. per capita per day of 16 hours was given as the flow to be expected. However, no flush closets or kitchen sinks were used on the border. In consequence this figure was increased to 25 gal. per capita, or 125,000 gal. in 16 hours, or at the rate of 188,000 in 24 hours. As the small creek into which the effluent would be discharged empties into Fall Creek, which in turn reaches White River above Indianapolis, gross pollution and nuisance must be prevented. An Imhoff tank followed by contact beds and sterilization were proposed and plans completed within the schedule time. However, the price of stone was so high, $3.59 per yd., that the contact bed was eliminated for a time at least. A contract was let, May 21, for the tank, a sludge bed and two miles of pipe, at $25,000. The plans for the tank are reproduced here in somewhat more detail than ordinarily the simplicity of the plant would warrant, as other camps may be confronted with a similar problem.



CAMP SEWAGE WILL PASS THROUGH TWO-STORY TANKS

The 3-hour capacity of the Imhoff tank gives a somewhat larger tank than normal, as the sewage will be quite fresh when it arrives. For the sludge chamber an assumption of 6 cu.ft. per 1000 population per day is less than normal, due to the fact that there will be received no garbage, industrial wastes and no solid-bearing miscellaneous drainage. The sludge-bed area was calculated on the basis of 200 sq.ft. per 1000 population, but for a five-month period only. The size of the contact bed was a compromise between the quantity and population load, the assumption being twice the normal 1000 population per acre-foot.

As to the details, the Imhoff tank is a reinforced-concrete structure with the hanging baffle made of expanded metal, plastered or formed, at the contractor's option. The sludge blowoff is by gravity with 5-ft. head. A 1½-in. lead pipe perforated with ½-in. holes extends around the upper edge of the sludge hopper, which, on account of its shape, obviates the necessity of reversing the flow.

The proposed contact bed has three units 16 ft. wide at one end, 62 ft. at the other, and is filled with 6 ft. of stone. The underdrain is a simple line of 10-in. vitrified pipe laid down the center on a slope of 1 to 200, into which, at 10-ft. intervals, 6-in. laterals drain. The distribution is unusual in that the 30-in. vitrified split pipe

is to be filled with ¼- to ½-in. stone to localize clogging. A peaked board roof in short sections will protect the split pipe from snow and ice in the winter and is easily removed to clean out local obstructions. The supply is to be regulated by "Pacific Flush Tank" siphons. An ingenious proportioner, to split into three portions the effluent from the tank going into the respective beds, consists of an overflow notch over each of the three shear gates.

The sludge-bed floors are sloped 1 in. to the foot in the clay to a central tile drain covered over with two sizes of gravel overlain with a 3-in. layer of sand. The two beds are each 22½ ft. square in plan, and the surrounding 6-in. walls are 3 ft. high.

Clamshell Digs First Cut on Subway in Boston

Top 22 Feet Taken Out by One Traveler and Disposed of by Industrial Railway—Total Direct Cost $1.47 a Yard

By PHILIP C. NASH
Assistant Engineer, Boston Transit Commission

THE TOP 22 ft. of a timbered cut for section *G* of the Dorchester tunnel in Boston has been taken out with a traveler and clamshell bucket, keeping pace with two ordinary hoisting rigs removing the lower lift and requiring only a small crew for its operation. It was possible to close the street, and the traveler moved down the middle of it ahead of the cut, taking out sections 25 ft. in length at a time. The dirt was disposed of in backfill or on a rented dump by industrial cars and two small locomotives.

The Dorchester subway is a continuation of the Cambridge subway through South Boston to Andrew Square in Dorchester. Section *G* is under Dorchester Ave. in South Boston, just beyond the Broadway station. The structure, which for most of this section has a flat reinforced-concrete roof with a center wall between the two tracks, is depressed until the top of rail is about 36 ft. below the street, on account of a crossing under a cut occupied by the New York, New Haven & Hartford R.R. The storage yards of this railroad occupy the space west of Dorchester Ave. at this point, while on the other side of the street are vacant lots and small shops having entrances from an alley in the rear. Short detours are available, so that it has been possible to shut off nearly all traffic on Dorchester Ave. and leave the subway cut open.

Traveler Excavates First Lift Between Bracing

A large A-frame derrick, shown in the photograph, has taken out the greater part of the excavation in sections the full 35-ft. width of the cut, 25 ft. long and 22 ft. deep. Although this rig is equipped with a Fogarty bucket, it does not have the extra boom generally used to bear down on the bucket and increase its digging power. This is not found necessary, and the derrick is rigged with a three-drum engine and swinging gear in the ordinary manner.

No longitudinal braces are used in the upper part of the excavation, so that the bucket can be operated between the cross-braces freely. These are 10 x 12-in. pine timbers, spaced 4 to 5 ft. apart vertically and 10 ft. apart horizontally. The sides of the cut are held by 3-in. sheeting driven by hand or with a small air hammer. Poling boards are used on part of the westerly side of the cut, as there is not room to drive the sheeting outside the industrial track.

The lower part of the cut is excavated by hand, loaded into ordinary skips and taken to derricks, which dump the skips into cars. During the time covered by the cost data given herewith, two of these derricks would fill five dump cars while the traveler was filling five more. The ten cars were then hauled to the dump or to the backfill by a locomotive. The dump, which was at one end of the job, was leased, and the industrial-railroad equipment used to reach it and the backfill comprised about 3000 ft. of track, 25 Koppel dump-cars of 1-yd. capacity and a Koppel steam locomotive, in addition to a Plymouth gasoline engine.

Costs for One Month's Winter Work

The material excavated by the traveler consists of 12 ft. of gravel fill, a layer of peat and successive layers of sand and clay. One small brick sewer encountered and a larger brick intercepting sewer, which last had to be broken up with sledges, were readily removed. The crew required with the traveler consists of a foreman, an engineer, two bracers and nine laborers. This gang could remove an average of 65 yd. of material in an 8-hr. shift. Accurate costs kept on this work for one month in January and February, 1917, indicate a direct cost of $1.47 per yard for excavating the material and placing it in backfill, which cost slightly more than carrying it to the dump, on account of the greater labor required in spreading.

COST OF EXCAVATING WITH CLAMSHELL

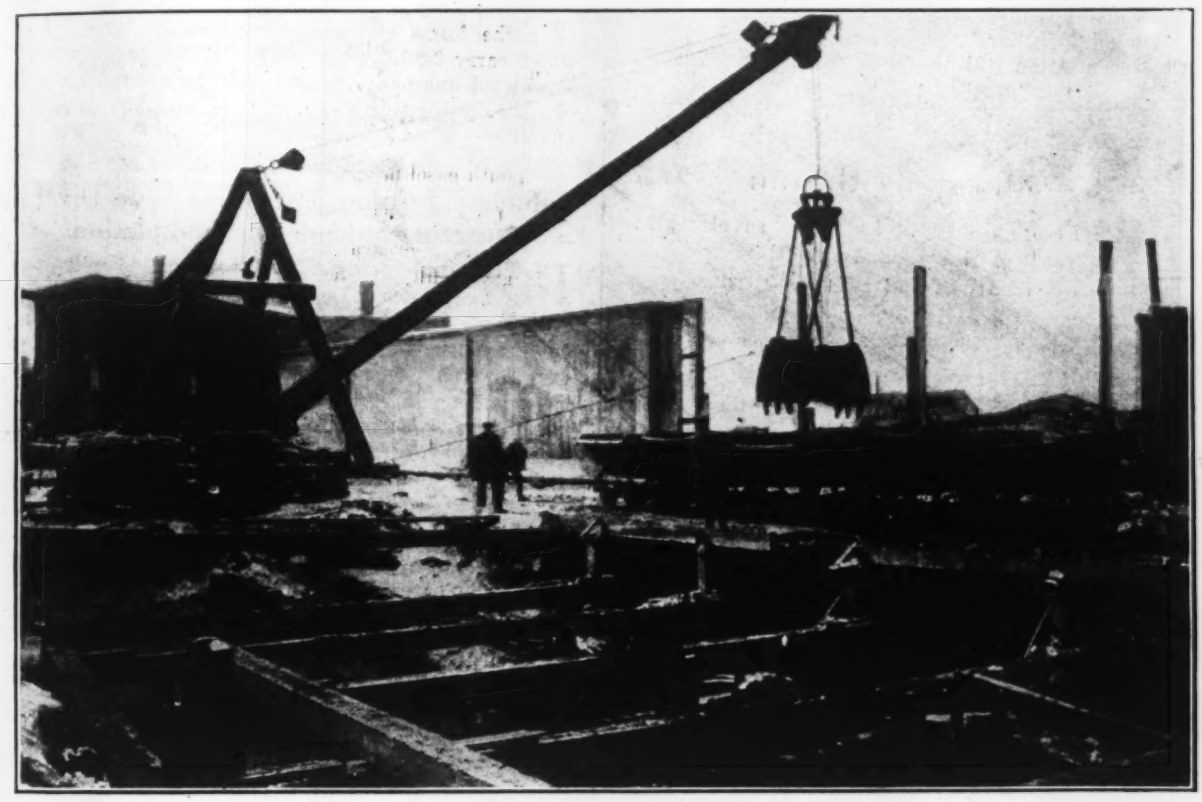
		Price per Cu.Yd.
Rent of equipment, fuel	$0.17	
Superintendent, timekeeper, foreman	.12	
Labor, engineer, bracers	.51	
Repairs and incidentals	.03	
Insurance	.07	
Lumber (bracing and sheeting)	.12	
Pumping	.09	
		$1.11
Hauling equipment, rent, fuel	.08	
Hauling, labor, insurance	.09	
		.17
Lease of dump	.06	
Dumping and spreading in backfill, labor, insurance	.13	.19
Total direct cost of handling material		$1.47

The figures for rental equipment given in the table assume the new cost of the entire traveler rig as $4000, on which basis $42 per week as rent for this equipment is charged to the work continuously, whether the equipment is idle or not. The estimated new cost of the hauling equipment is $6200, and $54 per week rental is allowed for it. Coal is figured at $6 per ton, the wages of an engineer at $4 per day, bracers at $3.20 per day, and labor at $2.25 per day of 8 hours. On this part of the work, lumber is used very economically, the bracing serving four times and the sheeting twice. Both kinds of lumber will have a large salvage value at the end of the job, and on this account $10 per M is charged for the lumber each time it is used.

Comparison with Cost of Excavating Bottom Lift

During the time these data were taken, five days were lost on account of stormy and extremely cold weather, and one day on account of repairs to the derrick. The costs, of course, are increased by frost and cold in comparison

with warm-weather costs for the same work. Data kept during February and March on the cost of taking out about 1400 yd. of excavation from the lower 20 ft. of the trench, the part not excavated by the traveler, indicate a direct charge of $2.39 per yd. for handling the material in the old way. Although bad weather interfered considerably with these operations and the amount excavated was scarcely enough to give average figures, the result at least indicates that the relative cost by the traveler method is much lower than in excavating by hand. Three-quarters of the whole cost of pumping is charged to the lower portion, and all the cost of the tongue-and-groove sheeting left permanently in place.



TRAVELER WITH GRAB-BUCKET EXCAVATOR. UPPER TWENTY FEET OF TWO-TRACK SUBWAY CUT REMOVED AT LOW COST

COST OF EXCAVATING SECOND LIFT BY HAND

	Price per Cu.Yd.
Rent of equipment, fuel	$0.13
Supervision	.21
Labor, engineer, bracers	.92
Air, hammers, repairs	.13
Pumping	.23
Insurance	.11
Lumber left in place	.27
Haul	.17
Dumping	.22
Total direct cost of handling material	$2.39

Both these tables omit overhead office expense, the cost of temporary repaving on the street, bond expense and other charges that would have to be added to get the total cost of the excavation to the contractor. The work described is being done under the supervision of the Boston Transit Commission, of which G. F. Swain is chairman and E. S. Davis chief engineer. W. W. Davis is engineer in charge, and the writer is assistant engineer on the work. The contractors are Coleman Bros.

Large Earth-Fill Dam Under Way on San Pablo Project

Seven cities on the east side of San Francisco Bay, representing a population of over 350,000, are supplied with water by the East Bay Water Co., of Oakland, Calif. This company has from time to time enlarged its system in accordance with a general plan worked out by its chief engineer, the late A. L. Adams. At the present time construction is under way on one of the units of this original scheme, known as the San Pablo project, which is to increase the service capacity of the present system by not less than 13,000,000 gal. daily over the most critical period of drought of which there is any record.

The project involves the construction of a hydraulic-fill dam 165 ft. high and about 1300 ft. long across San Pablo Canyon, impounding the waters of San Pablo Creek. The reservoir thus formed will have a capacity of 43,000 acre-feet and a drainage area of 32 square miles. By road it is located 20 miles from the center of the City of Oakland, but is actually less than 3 miles from the north end of the distributing system of the East Bay Water Co. The dam will contain approximately 1,500,000 cu.yd. and will have a cutoff trench 80 ft. deep, filled with selected sluiced material.

G. H. Wilhelm is chief engineer and general manager of the East Bay Water Co.; William Mulholland is consulting engineer, and A. Kempkey is engineer in charge of design and construction.

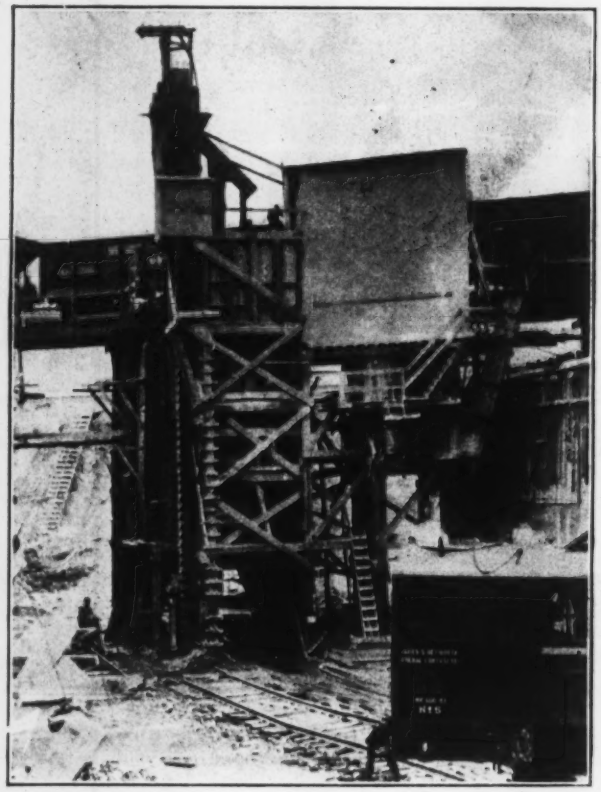
HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Handle Bulk Cement by Power in 40-Yard-an-Hour Concrete Plant on Big Canal

A LARGE concrete plant that uses bulk cement, unloaded from box-cars by a power scraper, has been installed by James O. Heyworth in constructing section No. 1 of the Calumet-Sag channel, at Chicago.

The mixing plant, which is located at Lambert, on the Chicago & Alton R.R., is set in the cut, which is 40 ft.



CONCRETE PLANT FOR CALUMET-SAG CHANNEL TO USE 30,000 BARRELS OF BULK CEMENT THIS YEAR

deep at this point. It is crossed by a trestle from which cars containing sand and gravel are unloaded into storage bins. A Hains-Weaver gravity mixer is used, and there was not sufficient room below the level of the track to charge this mixer by gravity from bins of the size desired. On this account, the storage bins feed a bucket elevator that loads smaller bins over the mixer. The mixer is hung below a platform that carries two large proportioning hoppers. The bulk cement is measured in two boxes, one located above each of these hoppers. It is fed from the bottom of the bulk-cement bin to the measuring box by a screw conveyor controlled by one of the men on the platform. With this system one man is able to charge both of the proportioning hoppers.

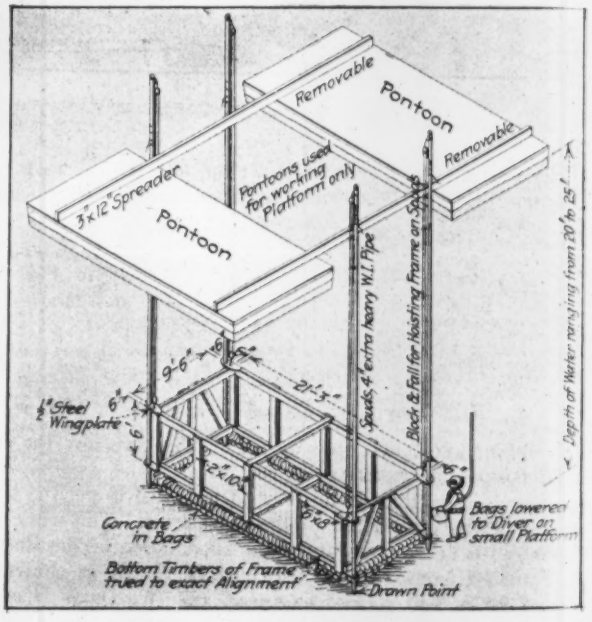
The bulk cement is stored in a 300-bbl. tight bin made of 1-in. flooring and covered with roofing paper. Cement is scooped from cars into the bin by a power shovel made by the Link-Belt Co. With this shovel two men can unload in about three hours a car containing 290 bbl. It is operated by a $\frac{5}{8}$-in. wire rope and a small motor that pulls it in either direction. The rope can be anchored in either end of the car. Very little hand shoveling is required for cleaning up.

The concrete is transported to the cranes which place it in the forms by an electric locomotive hauling cars which carry 2-yd. buckets. This mixing plant, which is considered unusually compact, will use about 30,000 bbl. of bulk cement this season and can mix 300 to 350 yd. of concrete in an 8-hour day.

Submerged Frame Used To Guide Diver in Setting Subaqueous Foundation

IN THE construction of the north guide wall of the Troy lock, described on p. 497 of this issue, a special framework was used to guide the diver who had to lay out the footings on which some reinforced-concrete cribs were lowered. These footings consisted of concrete in bags, laid up in a rectangular wall that leveled up the irregular rock surface to provide a base for the cribs, 21 ft. 3 in. by 9 ft. 6 in. in plan.

This scheme is shown in perspective in the accompanying view. It comprised a timber framework with spuds, made up of extra-heavy pipe on each corner, by which the frame could be raised or lowered. Floating between these spuds was a pontoon, which could be used for a working platform. In operation the spuds were first placed and located by the diver, with the work directed by an instrumentman above telephoning to the diver and controlling the movement of the frame from a derrick



DIVER SETS CONCRETE FOOTINGS BY GUIDE FRAMES LOWERED FROM ABOVE

the spuds once placed, the frame was lowered to the bottom and its proper elevation guaranteed by a long graduated rod resting on each corner, which was read from a level above the water. The bags of concrete were then lowered on a small platform to the diver, who filled in rows of one-bag width the space between the rock surface and the bottom of the frame. When the space had been entirely filled all the way around the frame, the latter was pulled up to the next location and a wall of concrete in bags left, giving proper grade and line to the lowering of the concrete crib.

Pavement Breakers Run by Gasoline Engine Built for Trench Work

By J. H. McGINN
Detroit, Mich.

THE CONCRETE breakers shown in the photograph were built for tearing up paving over the line of trenches for conduits, gas or water mains. Both are run by gasoline engines. The leads on one are hinged to fold down for moving, while the leads on the other are pivoted to swing to an arc of 6-ft. length, so that quite a wide trench can be broken in one movement of the machine.

After removing the wearing surface, the machine straddles the line of tracks, and the 600-lb. hammer, fitted

PIVOTED MACHINE CAN TURN TO BREAK STRIP 6 FT. WIDE

LEADS OF HINGED MACHINE CAN BE LOWERED FOR MOVING

with a wedged-shaped point, is raised and dropped to break up the base. The frame, brace members, leads and arc of the pivoted machine are made of 6-in. channel iron. The leads are lined with oak and are 9 ft. long. A pole inserted between straps on one of the horizontal braces is guided by one man to locate the hammer blows. The hammer is controlled by an ordinary 8-in. hand-operated clutch and foot brake, the clutch being geared to the 7-hp. gasoline engine. The machine is pulled along the line of the tracks by a hand windlass and rope attached to a bar driven in the pavement some distance ahead. It can be moved from job to job with ease by one team. It is also capable of cutting sheet asphalt to a very accurate line.

The second machine is provided with a chain drive instead of gears. Both machines were designed and built by Raymond A. Mercier, superintendent for J. A. Mercier, contractor, of Detroit.

Use Sectional Camp Buildings on Winnipeg Aqueduct, but Move Them Whole

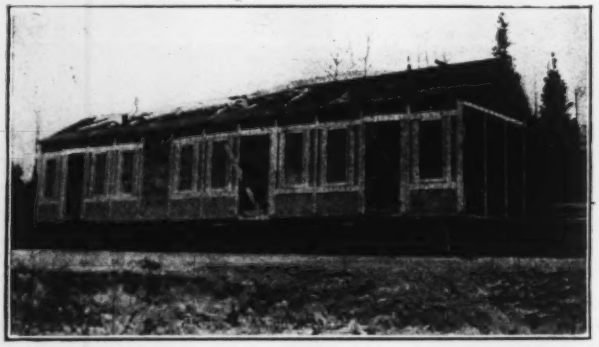
By WILLIAM SMAILL
Superintendent, Winnipeg Aqueduct Construction Co., Ltd., Winnipeg, Man.

ON THE construction of the upper half of the Winnipeg Aqueduct, described on pp. 121 and 180 of *Engineering News-Record* for Apr. 19 and 26, 1917, eight movable camps were maintained during 1916, and more have been put in use this year. Although the camp buildings were designed so that any portion could be taken down in 4-ft. panels, the sections being fastened by bolts, it was found after trial that they could be moved more economically by taking the smaller ones bodily and the larger ones in two sections to the next site on push-cars, as shown in the photograph. The buildings were loaded onto a train of push-cars on the standard-gage

railway, pushed to the new location by hand between trains, and taken off and transported to place on rollers and skids.

The camps are moved once a year and placed on the driest spot that can be found near the center of the work to be finished that season. The men use hand-cars on the railway track going to and from work, the longest pump not exceeding 1½ miles. This plan was adopted in preference to the original one of moving the camps twice a year and having the men walk to work.

The camp buildings are well screened and provided with ample ventilation. The bunks are of steel, with springs and mattresses. All the laborers in this country



CAMP BUILDINGS ARE MOVED EVERY SEASON

carry their own bedding, and a man who came into camp without this necessary equipment would be looked on by the others as the poorest kind of hobo.

Water for drinking and kitchen use is generally obtained by driving well points and installing hand pumps, where convenient locations for them can be found near the camps. At other places, where it is necessary to use groundwater, wells are dug, a well point and pump set in the well, and the hole is filled up with gravel and sand to make a filter bed. All refuse is burned in home-made incinerators of concrete.

Men Scorn Shower Baths

The camps are also provided with shower baths, but the men generally seem to prefer using the small rivers or drainage ditches for bathing or washing clothing. At one camp, where there were a considerable number of Finlanders, they built a regular Finnish bathhouse out of logs, and it was in use at least once or twice every week.

Where sufficient interest was shown, the Reading Camp Association erected tents for reading purposes and for use as night schools at different camps. The night schools were not so well patronized as they might have been, though the fault was not really that of the men. Labor was so short that long hours were necessary to keep up progress, and the men were grateful for the books and reading matter provided at these tents.

There is a hospital situated near the center of the work at Mile 77, where minor ailments and injuries are attended to, any serious cases being sent to the city. The headquarters, repair shops and field office of the company are on the Whitemouth River, where there is a small settlement of houses named Reynolds, in memory of the late chairman of the Commissioners of the Winnipeg Aqueduct—S. H. Reynolds.

Provide Cement-Gun Operator with Whistle Cord

By C. H. CHALMERS
Great Falls, Mont.

TO PREVENT filling up the hose of a cement gun when the line is kinked or stopped with wet sand, the writer has attached a small steam whistle to the air receiver and run the whistle cord to the nozzle. In cases where the nozzle is some distance from the gun, this device has saved much delay. If the feed on the gun remains open when the hose clogs, it rapidly fills the entire hose between the kink and the gun. To clean the hose out again is a considerable job. The difficulty of reaching the man at the cement gun quickly enough to have him shut off the supply before the hose would fill led to the use of the whistle, two toots being the nozzleman's signal to shut off the supply, and one to turn it on again.

On occasions when the sand was so wet that it clogged constantly, some hot sand was secured from a street-paving outfit nearby and mixed one part of hot with three parts of wet sand, which worked very well.

Timber Grip Brakes on Rear Wheels of Heavy Trucks for Steep Grades

A BRAKE that grips the rear wheels on the wagon between two 8 x 10-in. timbers and is operated with handwheels and screws is used by the construction department of the Rochester Railway and Light Co., of Rochester, N. Y., in transporting transformers and other heavy parts by wagon. As shown in the photograph, the

GRIP BRAKE LOCKS WHEELS ON STEEP GRADES

screw rods are placed just inside the wheels of the wagon. This brake alone will hold a load of 10 tons on a steep incline. For heavier loads the timber shown dragging on the ground is used in addition. Where the loads reach 25 tons and the grade is steep, one or two teams of horses are hitched to this dragging timber, holding back on the wagon.

The device was described in a recent issue of *Gas and Electric News*, the publication of the Rochester Railway and Light Company.

EDITORIALS

Dividends from an Engineering Investment

THERE is a double significance in the report of Commissioner John T. Fetherston of the New York City Department of Street Cleaning, reprinted in part on page 501. First, New York is getting cleaner streets at less cost than she did under former administrations. Second, these results are due directly to the fact that engineering principles, instead of politics, have been made the basis of the conduct of the work. Other cities with streets to clean will do well to grasp this fact. The call now is for a reduction in the extravagance with which many municipal utilities are operated. Many localities could make a good beginning by placing an engineer at the head of their street-cleaning organization. This kind of an investment is sure to yield dividends.

The First Line of Sanitary Defense

IN CITY and army, engineer's field party and contractor's camp, on railway trains, in shops and in the home, the first line of sanitary defense is always the water-supply. But let us remember that when the country needs every dollar there must be no running after fetiches of sanitation. It is worth emphasizing that safety lies in water purification rather than in sewage treatment. Happily we know better now than ever before the essentials of a safe water-supply. The arch enemy is the water-borne disease germ. If it cannot be kept out of the water-supply, it can and must be put out by filtration, chlorination or other disinfecting agency. In municipalities, if through war demands or other demands it becomes necessary to lessen outlays for new construction or for operating expenses, the water-supply should be the last place for financial curtailment in any way that may threaten health. Water-purification plants should still be built where needed, and in existing plants there should be no lowering of the standard of purification. It would be the falsest of false economy to dispense with the services of experienced filter operators, bacteriologists, sanitary chemists or stream inspectors.

Land Drainage Needs Pushing

MILLIONS of acres of fertile virgin land lie idle, and other millions yield half or less their potential capacity, for lack of ditches that might be easily, quickly and cheaply dug with the very ingenious and efficient trenching machines now available. Of the many drainage projects now under way or being promoted there is danger that some will be given up and others not pushed as they should be, owing to inertia, opposition, misunderstanding and other removable obstacles. Engineers and contractors should strive to arouse, inform and enlist landowners and drainage districts to go on with all possible speed. Every acre unwatered and planted will add to the food supply, wealth, stability and power of the nation. What can be done quickest and with least expense should be done first. The greatest quick-yielding possibility is to improve the drainage of land already under cultivation. In selecting new drainage projects areas should be chosen which will not require clearing. Obviously, land already drained but not yet cleared or wholly cleared should be made ready for cultivation before new projects are started. It should be remembered that efficient machinery for land clearing as well as for ditch digging is available. Both should be used to the utmost.

Why Another Society Now?

THE organizers of the new "Society of Industrial Engineers" owe it to their professional brothers and the country at large to explain why there is need now for a new engineering society. When the country demands all available thought and effort to deal with its tremendous national problems, can it allow some of it to be diverted to such experimental development work as the starting of new societies? We believe that this question calls for answer. The proceedings of the rather small organizing meeting held at Chicago on May 26 did not supply the answer. They only emphasized the fact that other societies have already done work in the field that the newcomer plans to appropriate.

Enforcing Safety on Construction

CARRYING out engineering work always has involved considerable personal hazard for the workman. Contractors and engineers know this, yet the accident list on a large job is frequently long and heavy. Half of the accidents are preventable, announces the California Industrial Accident Commission, and with this as a starting point the commission has undertaken to bring about a radical change of policy on construction work. In times past the humanitarian views of those in charge or the possibilities of delaying the work were the only inducements for real effort toward making the job safe for workmen. Then came the employers' liability acts. To the contractor these simply meant that he would have to take out liability insurance; except when the insurance company insisted, there were but few more precautionary measures than before. The California commission, however, has undertaken to keep the enforcement of safety measures on construction entirely within the hands of state officials. As described by Mr. Rosenthal elsewhere in this issue, safety orders are now in effect in that state under which contractors can be compelled by state safety inspectors to observe safety rules. The inspectors do more than this: They confer with the contractor and help him figure out the least costly way of applying safety measures to his particular job—a logical outcome of the safety move. The prospects are good that many features of the California plan will in time find general adoption. This will constitute a large forward step. It is likely also to bring about a decrease in the present high rates on liability insurance.

Rush Work on Army Camps Must Not Be Delayed by Red Tape

EVER since the Army Draft Bill became a law the air has been thick with conflicting rumors regarding the construction of the big training camps. Even now the atmosphere is far from clear. One day we hear that there are to be thirty-two camps; the next, that only sixteen are to be built, because of insufficient funds. From one source comes the report that all of the buildings are to be of wood, while a few hours later we are told that a large proportion of the men are to live under canvas. Scores of localities have been named, unofficially, as sites for the camps, but changes are made with such rapidity that even one who is well-grounded in geography soon loses his bearings. If general plans and sites for camps have been decided upon—and certainly those in charge have had more than enough time for making a decision—it would be well to make the decision public at once.

A sudden call for a score or more of full-sized cities—and that is just what the camps, each with its 20,000 to 30,000 inhabitants, will be—naturally causes confusion. Yet one feature of the proposed work indicates that some sound thinking is going on in Washington. It appears certain now that the Government officials, acting upon the advice of a committee of civilian engineers and construction men, will break away from the usual form of contract for such work and make awards for the big camp construction programs on the basis of cost plus a percentage, without competitive bidding. In fact, such a form of contract has been evolved and is ready for use as soon as Congress provides money for the work. There are provisions in it governing the quality of the work and the time when it must be completed, but it is in the basis of payment that the big change occurs—so far as Government contracts are concerned. The schedule, in its recommended form, would allow the contractor cost plus 10 per cent. on jobs of $100,000 or less; cost plus 8 per cent. between $100,000 and $250,000; cost plus 7½ per cent. between $250,000 and $500,000; and cost plus 7 per cent. for work costing more than $500,000. Allowance for all small tools and supplies is to be made in the total cost, while heavy equipment will be paid for on a rental basis. Operations of the magnitude contemplated will involve a big financial outlay by the contractors. It is of prime importance, therefore, that they receive payment promptly and this result will be achieved by the clause stipulating 100 per cent. payment for work done during one month on the ninth day of the following month.

The camp-building program demands the services of only the highest grade of contractors who have the resources and the organizations to put through $3,000,000 to $5,000,000 worth of work in about three months. The authorities at Washington will act wisely, therefore, if they intrust the assignment of these huge jobs to the advisory board of engineers which is working in cooperation with the Quartermaster Department and the Corps of Engineers. This board is in a position to assign the work to the hands best qualified to do it quickly and well. Red tape must be dispensed with. The crying need is for quick action. Precedent, so far as form of contract and method of letting are concerned, must go into the discard.

Of course, this method of procedure will have its critics. There will be cries of favoritism and excessive cost. As to the former, we must depend for a square deal upon the Quartermaster Department officials and their civilian advisers. In the matter of cost we must realize at the outset that emergencies such as the present one are not times for bargain hunting. We want work on a vast scale done in an incredibly short time, and we will have to pay for it. With the labor and material market in its present condition, and tending no one knows whither, it is safe to say that only the most reckless type of contractor would gamble on the camp jobs with the usual hard and fast kind of agreement. And it is the reckless contractor, who will take a chance on going broke, who should be kept off this rush camp construction. The Government doesn't want work started, suspended, and finished way behind schedule by the bondsman of a broken contractor. It is work for picked men, men whose ability on large-scale undertakings has been demonstrated by past performances. There is a plentiful supply of contractors qualified to handle the camp construction and finish it on time, provided useless cogs are eliminated from the administrative machinery.

Military Strategy and the Good Roads Propaganda

A GREAT deal of nonsense is being talked these days about strategic roads. The powers at Washington are being flooded with vague suggestions and with definite projects for highways pretending to military advantage, by advocates with only the slightest conception of military strategy in the broad sense or the particular defense needs in the locality they propose defending. A typical effort has been made by a Western good-roads convention, which in the course of a long resolution advocating a Pacific Coast military highway said: "There are hundreds of miles of shore line along the Pacific Coast totally unprotected and absolutely inaccessible from the interior, but easily approached and open to attack from the sea. It is obvious that not only the Pacific slope, but the entire country, is wide open to hostile invasion." Now, any boy scout would know that the proper strategy of such a situation is not to build a highway permitting the defense of these shores, but to allow the enemy to land and then to starve him to death or submission by a naval blockade, unless, of course, the fear is that he will find a one-way road from the "absolutely inaccessible" coast to the rich and undefended hinterland.

Joking aside, such propaganda and an equally foolish proposition actually made to the Council of National Defense to build two hard-surface roads from Chicago to the Atlantic for the sole use of motor-truck transport of grain, serve only to take official and public notice away from really needed roadwork. Some of these needed roads may turn out to have military value, but their primary service to the country is economic and social. To get foodstuffs to the market or to the uncongested railway terminals and to get manufactured products from the factory to the jobber or even to the consumer are immediate necessities far more imperative than to concentrate artillery or men on some specific spot on either coast line.

For main-line transportation the railway is infinitely cheaper and more efficient than the road; and for ocean-freight transfer the terminal problem, which reduces the railway's efficiency, is equally present on the highway. But the freight congestion in and around inland centers, where terminal tie-ups extend 50 to 100 miles out from the big railway yards, can be definitely relieved by motor-truck transport. It may involve somewhat increased expense, to be sure, but it offers assured delivery. For this type of work, which is growing daily around our Middle Western cities, good roads are needed, and are needed immediately.

Let the good-roads advocates leave the military problems to those competent to consider them, and bend their energies to promoting the construction, not of main-line or through thoroughfares, not of roads to carry some American analogue of the mythical motor busses that saved Paris from von Kluck, but radial highways connecting the all-necessary farmer with the market and making the manufacturer independent of the freight delays at congested city terminals.

The Call To Coöperation Sounded Again

A MASTERFUL analysis of the great problem of the engineering profession—namely, how it can properly register in the world's book of achievement—is contained in the address of Gardner S. Williams, abstracted on page 500. The immediate problem, which he believes can be solved by coöperation, is so to unite and organize the 200,000 citizens intimately connected with engineering that their influence may be most potent for the advancement of society and incidentally for that of engineering itself. He believes that the Engineering Council of the national societies, with their 30,000 members, is well adapted to this purpose, if they can be brought to see the advantages to come from an extension of the Council beyond the limits of their own membership. There should be little difficulty, he feels, in gathering into the combination the 90,000 (more or less) engineers now affiliated with the national, state and local societies. But there would still be left the great army of more than equal size that is wholly unorganized, among whose members the American Association of Engineers—which Mr. Williams calls the embodiment of the democracy of engineering—has its greatest field. He puts it up squarely to the national societies, denominated the aristocracy, to take their places as leaders in bringing about that complete coöperation which would utilize all engineering forces of this commonwealth; but maintains that if the nationals do not work out a plan, only then will it be time to turn to other agencies.

This is the same "watchful waiting" argument that nipped in the bud the plans of the Conference on Coöperation. Probably it was for the best that the delegates to that body parted in harmony and agreed to wait. Nevertheless, there is little doubt that by now a paid traveling secretary would be revitalizing many a local organization to the nation's needs. And there is a need for engineers to get behind local military work.

Individually, engineers are doing their share most splendidly, but as society units the plans of the national societies have worked best east of the Alleghenies. There is no definite representative to carry home any unified message to the constituency of the nationals, let alone to the 60,000 local and state members and to the remainder of the 200,000. In Chicago, for instance, little or no effort is now being put forth to aid recruiting by any engineering society other than the American Association of Engineers, which has given space in its limited quarters for a recruiting station and has circularized its whole mailing list with recruiting literature. The latest proposal of this organization is the promulgation of a home appreciation service, whereby engineers at home will be appointed to stand sponsors for engineers at the front; to keep them in touch with engineering happenings at home and upon their return from service to place them in daily affairs with advantage due their rank as citizens rather than in competition with those who have remained within the safety of their defense. There is no monopoly on this idea. It is at least 8000 years old. The Chinese Wall was built on the same, or even stronger, fellowship basis. A wall worker's field was tilled by proxy, places being exchanged every year.

Enough abstract purposes noted by Mr. Williams and sufficient instances of daily concrete needs have been enumerated to indicate that the Engineering Council should be under way at full speed. If its organization needs altering—and frankly *Engineering News-Record* thinks it does—no time should be lost in providing a truly democratic representation of the whole 200,000.

What Value Has a Questionnaire?

WE desire to commend the spirit shown by the Universal Portland Cement Co. in trying to determine through a questionnaire the best practice concerning the use of a sub-base for a concrete roadway. But the value of the attempt is debatable. Extracted as in the issue of May 31, p. 459, it merely serves to show that opinion and experience must necessarily vary from place to place and from man to man. Except in a matter where the elements are simple, clearly defined and not susceptible to varied interpretation, the value of a questionnaire is slight, if not entirely negligible. Strictly speaking, there can never be a consensus of opinion, for opinion is based not merely on facts as they are met with, but so much upon the answerer's previous and disconnected experience, as well as upon tradition, that an attempt to draw an average conclusion is bound to be misleading.

It is safe for one to rest on the general principle that questionnaires should not attempt to deal with opinion, but should cover only accomplished fact—that is, things which exist or actions that have been taken. In the present case, even to publish the replies in extended form would not have been sufficient, in itself, to make the matter clear to those into whose hands the data fell. It is hoped that the compilers are in a position to furnish copies of the replies to any who may apply. Correspondence with the engineers who sent in answers would reveal the qualifying circumstances and allow any interested engineer to form a judgment from weighted values. Some benefit, perhaps, might be derived from the very extent of the experience that was drawn upon to furnish the answers.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Steel Was Out of Place in Concrete Building Tested at Seattle

Sir—In the Apr. 19, 1917, issue of *Engineering News-Record* appeared an article under the caption, "Second Test of Seattle Flat-Slab Warehouse Shows Some Decrease in Stresses."

The test was skillfully made, and the record of deformations is correctly given; but due prominence was not given to the gross misplacement of steel. The survey of the steel was thorough and indicated a more general misplacement than in the panels of the first test. The survey showed that not a single rod where subjected to negative stress, in the panels of the second test, was properly placed; and many of the rods where subjected to positive stress, "particularly in the direct bands between columns," are out of place to a considerable extent. The readers of *Engineering News-Record* should clearly understand that the designers were not charged with the supervision of the erection of the building and that the two tests relate to a warehouse as constructed and are not conclusive as to the design.

A. O. Powell.
Consulting Civil Engineer.

Seattle, Wash.

Tidal-Water Sewer Outlets

Sir—The question raised in your issue of Apr. 26, 1917, p. 219, by Kenneth Allen regarding the effect of the admission of tidal waters into the sewers of a city is one which deserves the consideration he suggests.

In this city a considerable area of the business and wholesale district has an elevation of 15¼ ft. above mean sea level and an average elevation above ordinary high water of 9 ft. The main sewers are designed with storm outlets protected by hinged tidal valves; but the ordinary sewage flow is taken out to deep water by submerged pipes, the inlet to which is on the sewer side of the tidal valve. The tidal valve therefore only serves to protect the mouth of the sewer against the entry of logs or other floating matter and does not prevent tide water from entering the sewer.

Under certain tidal conditions there is no doubt that the direction of the current is reversed, and if a heavy rainfall occurs under these conditions a considerable head above the tidal level has to be created in the sewers to cause the tidal flow to reverse and allow of the normal outflow of storm water. As architects when designing buildings generally consider that the basement level will be safe if just above tide level, the conditions just named cause the flooding of basements and the consequent liability of the city to be sued for damages.

Under ordinary conditions sewers seldom run more than half full, and the level is constantly changing, so that deposits or growth on the edge of the flow is not a serious matter. In sewers which tidal waters enter, the lower temperature of the tidal water congeals the grease and the upper half of the sewers is coated with a thick greasy deposit, which after a time assumes a stalactitic appearance, extending down sometimes to half the diameter of the sewer. This must tend to reduce the flow by increasing the coefficient of friction. It would also appear that the presence of this greasy deposit in the sewer, and the entrapment on it of filth and bacteria, must have a prejudicial effect on the atmosphere.

In a city where sewage is separated from all storm and surface water pumping is not a very serious matter. But with a city sewer on the combined system and liable to continuous or intense rainfall, the amount to be pumped is considerable and the annual charges heavy.

In Blackpool, England, the conditions are met by the installation of an electric pumping equipment which comes into action automatically when the sewage has risen to a height of 13½ ft. above mean sea level, or about 4 ft. below ordinary spring tides. The pumps and motors are set horizontally in a chamber 2½ ft. above mean sea level, so that the pumps need no priming. This installation has been in use over twelve years and Mr. Brodie, the engineer in charge, informs me that it has been very satisfactory. If there is a similar installation on the American Continent, the particulars would be interesting.

The cleaning of submerged sewers of large size is difficult and unpleasant work, the difficulty being greater in old sewers because no provision has been made for the entry of suitable apparatus.

In all large sewers it is desirable that there should be a manhole or side entrance chamber with an opening large enough to permit barrows or trucks being taken into the sewers.

A. G. Dalzell.
Engineer of Sewers.

Vancouver, B. C.

Concrete Consistency Not a Measure of Prospective Strength

Sir—Harold A. Thomas' article in *Engineering News-Record*, May 3, 1917, p. 244, entitled "Concrete Consistency Measured by a Simple Field Test," is open to the criticism that it is based on the wrong assumption, that the consistency of freshly mixed concrete is, in and of itself, a matter of importance. There is no doubt that this is sometimes the case, as where concrete is handled by gravity, or where very dry concrete is to be tamped into heavy forms and the dryness affects the amount of tamping that can be given to it; but so far as the concrete is concerned, the consistency of the mix is of no importance whatsoever except as indicating in a very crude fashion something about some of the factors that do directly affect the strength of the concrete. To propose a rough measure for consistency is therefore merely to propose a rough measure of vitally important factors and so serves to make the conclusions drawn more inaccurate rather than more accurate.

To put this in a little different fashion, consistency is the resultant of a number of factors—the amount of water used, the thoroughness of mixing and the amount of, let us say, "fluxing materials," such as hydrated lime or clay used in the batch. Now each of these is a factor of primary importance, a factor directly affecting the

strength of the resulting concrete; but as the consistency of the batch is a resultant of all these and of other factors as well, it can be only an extremely crude measure of whether or not each of these factors has had proper consideration in working up the batch, or of whether or not the final product will be good concrete.

To illustrate further, suppose that, as suggested by the author of the article referred to, a certain consistency is required by the specifications. It may be obtained with any given materials: (1) By undermixing and the use of too much water; (2) by the use of less water than is customarily employed, and by extremely thorough mixing; (3) by undermixing and the addition of a percentage of hydrated lime; (4) by the use of a proper amount of water, either with or without hydrated lime, and by proper mixing.

Doubtless other combinations could be mentioned, though these are the ones most likely to be met with in practice. Now combinations (1) and (3) are bad, though they would pass inspection under a consistency specification as easily as combination (4), which is good, or combination (2), which may be said to be above par. The simple truth is that any good foreman could meet the proposed specification with undermixed and overwatered concrete even more easily than with a good mix, because he could, under such a specification, overwet his concrete, turn it over a couple of times and turn it out, thus saving an enormous amount of plant time; but the resulting concrete would be anything but first-class material.

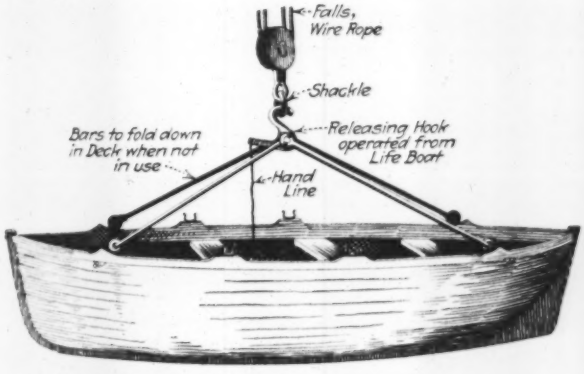
What engineers really need is some measure for the vital factors themselves, some practical way of getting down to the bottom of the question as to whether these factors have each been given proper weight in scheduling the mix.

J. P. HARRISON.

New York City.

Lower Lifeboats with Sling

Sir—In these times of submarine warfare, any improvement in the method of lowering lifeboats at sea should be welcome. It has been evident for a long while—long before the time of the "Titanic" disaster—that the usual methods, still in use today, are not nearly good enough. In order to invite discussion, I submit the following:



SLING SUGGESTED FOR LOWERING LIFEBOATS

The present method of lowering lifeboats by means of a fall at each end has not proved satisfactory, as is well known. Many lives are lost owing to the fact that one end is often lowered quicker than the other, and the passengers are thereby thrown overboard.

I would suggest, therefore, using a sling, so that the boat could be lowered by one fall; this sling to be made preferably of bar iron coupled together in the center with a pin and having a self-releasing hook, so that when the lifeboat is waterborne there would be no difficulty in releasing it. Bars are suggested instead of chain or wire rope, because after release they would not fall and strike the occupants of the boat. Wire-rope falls would be preferable to manila, as in freezing weather the latter often jam.

Another advantage of using a sling with one lowering fall would be that the lifeboats could be lowered very rapidly and safely by using the mast and boom derrick usually placed on freight vessels.

EUGENE W. STERN,
Chief Engineer of Highways,
New York City. Borough of Manhattan.

Hold Engineer Students Back!

Sir—In the editorial on p. 321 of your issue of May 10 you recommend "to the War and Navy Departments and to Congress and the Council of National Defense, that the land-grant colleges be led to organize and cooperate for completing the training of the technical students now partially educated."

Do you limit this work to the land-grant colleges because you feel that they are the only educational institutions over which there may be quasi or actual federal control, or for some other reason? If I understood the Secretary of War correctly in an address that he made to college presidents May 5, it is his opinion that all institutions of higher learning, giving courses in medicine, chemistry, engineering, or agriculture, should encourage the undergraduate students in these subjects to remain at their tasks until their courses are completed, and it seems to me that this is a most wise position for these institutions to take. If, however, the control of selection is left with local civilian boards, some rather authoritative advice from the federal government or from the governors of the states having the matter in control should be given to these boards.

But the purpose of this note was to ask why land-grant colleges alone? Why not all technical institutions?

WILLIAM G. RAYMOND,
Dean, College of Applied Science,
Iowa City, Iowa. University of Iowa.

[Dean Raymond's point is well taken. The reference should have applied to all technical institutions, not merely to land-grant colleges.—Editor.]

Clay from Mines To Make Brick

The clay excavated incidental to coal mining in Illinois gives promise of being cheaper for the manufacture of clay products than clay dug specifically for the purpose. Such clay could also be produced in winter weather, which closes down surface pits. Tests have recently been made by the Ceramics Department of the University of Illinois on clay from coal mines. About 50% of the samples studied showed satisfactory material. Results are contained in Bulletin 18, published by the Illinois Geological Survey, at Urbana, Illinois.

Engineering Society Service

A Section Dealing with the Results of Teamwork by Technical Men

FAR more engineering societies are rendering civic service than most of us realize. With the awakening of the engineer to the responsibility of shouldering civic duties by reason of his peculiar fitness to solve community problems, naturally there has come a similar awakening of the local engineering organization. All men, engineers included, are realizing as never before the possibilities of combined effort. To make available the story of this development will help the "other" society.

Having in mind that a much desired impetus and friendly rivalry may be engendered by so doing, *Engineering News-Record* proposes to render its service by telling of the civic activities of a number of local organizations. To this end, correspondence along the following lines is invited:

What part has your organization taken during the past year in community activities? With what success?

Looking backward, what plans might have been modified to advantage?

What were the elements that led to success or failure?

Have you devised a way to get proper publicity of engineering activities?

Have you assisted in putting engineers into civic places?

How about the employment question?

In What Way Is Your Organization Making Its Influence Felt ?

Rochester a Live One

Committees of the Rochester (N. Y.) Engineering Society, acting with the Chamber of Commerce and Builders' Exchange, have drawn up and succeeded in putting into use a set of building standards. The society has organized an Engineer Reserve Corps of the United States Army and enlisted 41 members. Drills and lectures are held twice a week. Publicity is conducted by a newspaper man, who writes up matters of interest to the society and places them in various local papers.

Wholly aside from these special activities, the society has a healthy normal life. Sixty meetings are held each year, with a maximum attendance of 500 and an average of 75. The 350 members include manufacturers as well as engineers and contractors. Invitations to meetings are exchanged with the American Institute of Electrical Engineers and also with the chemical and optical societies.

From September to June a paper or lecture is presented nearly every Friday night. Tuesday luncheons followed by 30-min. talks are held throughout the winter. Several automobile excursions to points of engineering interest are held on Saturdays.

Columbus Engineers Organize

Growth is the notable feature of the new Engineers' Club of Columbus, Ohio. Reorganized a few months ago from the embers of the old club, which originated in 1896 and became extinct in 1909, the present club has already 150 members and aspires to the 500 mark in its membership campaign soon to be launched. It hopes to be a useful unit in the field of engineering coöperation as well as to contribute information and assistance to the city.

Philadelphia Club Is Large

Since the Engineers' Club of Philadelphia made its sensational campaign for members in November, 1915, under direction of professional managers, following a revision of its by-laws providing for affiliation with other local engineering organizations—eight are now in—its activities have been numerous. An item of work of civic helpfulness, recognized as such by the city's Department of Public Works, was the presentation of papers on "The Zoning System," at the January meeting, shortly after a commission on the zoning system in Philadelphia had been appointed by the mayor. The city ordered 3000 copies of the paper printed for general distribution.

Publicity of other papers of general interest has been arranged for. An employment bureau assists members and employers, the wants of both parties being published in the monthly proceedings of the society.

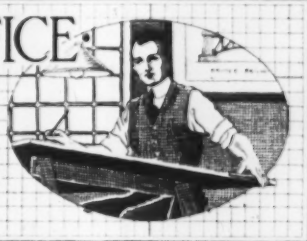
Forced to hold its meetings outside of the clubhouse and cramped for dining-room space, this organization, which now numbers 2500, has under consideration temporary expansion into adjacent property. Ultimately, it is the hope of the development committee that a site may be secured and built upon on property adjacent to that which the Franklin Institute, with its nationally known library, proposes to improve, on the line of the Parkway.

Proposes Home Appreciation Service

As an appreciation of the sacrifice that must come to engineers who enlist, the president of the American Association of Engineers has proposed a sponsorship idea that every society may easily take up without undue burden. Its purpose is to stimulate recruiting, to promote a greater spirit of patriotism in the citizens at home and to supply renewed spirit of courage and willingness in the man at the front. Briefly, the scheme is to provide five sponsors, personally interested in the courage, welfare and return of every enlisted man. The sponsors, appointed from the society's home ranks, are to keep the soldier informed monthly of events at home in connection with his former activities. Upon his return from service, if the supreme sacrifice has been made the society is to see that he is buried with due honors to his profession, and if alive, to place him in the community with the advantage due his rank as a good citizen, rather than in competition with those who have remained within the safety of his defense.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT
DEVOTED TO DETAILS OF THE DAY'S WORK



Standard Scale for Sieves Adopted

A RECENT conference consisting of representatives from committees of the various national engineering societies, the Government departments and private interests, held at the United States Bureau of Standards, recommended the adoption of a standard screen scale based on the metric system. A sieve having an opening of 1 mm. is made basic. The ratio of the width of one opening to the next smaller opening for openings between 1 mm. and 8 mm. is the square root of 2, or 1.414; and for sieves smaller than 1 mm. the ratio is the fourth root of 2, or 1.189. The sieves of this series are to be identified by the width in millimeters of the opening.

A New Subgrader Design for Maximum Efficiency and Minimum Attention

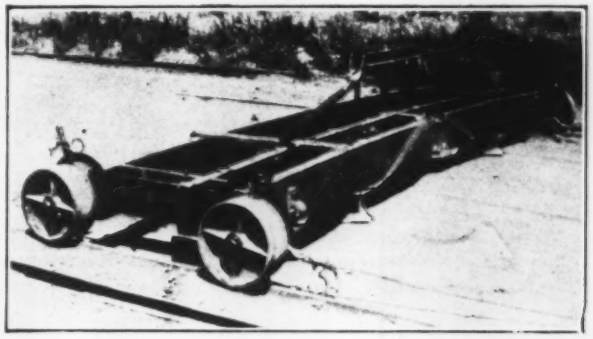
INSTEAD of the usual scraper blade at right angles to the center line of the road, a new subgrader, designed by E. G. Carr, of San Francisco, has four pairs of plow-shaped blades arranged to balance the thrust. These are set at an angle with the center line, and as a result the tendency to pile up earth ahead of the grader is avoided. This feature makes possible more work of a satisfactory character than is obtainable from the ordinary type of subgrader. Furthermore, the work is done with fewer laborers than in the case of the ordinary subgrader, which requires the attendance of from two to four men.

The illustration on p. 207 of the Apr. 26 issue of *Engineering News-Record* shows the operation of a subgrader on which four men with shovels are required to assist in the work of removing the surplus earth from in front of the subgrader. During this period the subgrader must be stopped. The accompanying illustration shows the new subgrader in action without assistance from shovelers.

LESS TRACTIVE EFFORT IS REQUIRED TO HAUL NEW SUBGRADER

A feature of the new device is the quadrant and lever regulation of the blade, whereby the height of the blade can be adjusted in a few seconds without the use of special tools. This arrangement also permits raising the blades until the scraper rests on a central circular plate, or turntable, in which position it can be easily swung parallel to the center line of the road to allow space for passing vehicles, or so that it may be trundled off the graded roadbed. Although the thrust is equalized by placing the blades in pairs, angle irons are provided as guides to keep the wheels on the header.

Since the blades shear through the material rather than pile it up ahead, depressions in the subgrade are avoided to a great extent. The grade may be controlled to a nicety on account of the clean action of the plow blade, and thus a considerable saving in concrete is effected. It is notable that the setting of the blade at acute angles has reduced the tractive effort below that required by the ordinary grader. The most effective work has been done when the grader is hauled by cables running from its extreme ends to the tractor, which is kept about 30 ft. in advance.



QUADRANT AND LEVER PERMIT QUICK AND NICE ADJUSTMENT

Moisture—the Enemy of Building Timber

Field and laboratory studies by the Forest Products Laboratory indicate that much more care should be exercised in the selection of timber and in the construction of buildings to avoid conditions favorable to decay. A number of inspections of buildings which have given trouble on account of decay have shown that any one of the following causes may result in rapid deterioration of the building:

1. The use of green timber.
2. Allowing timber to get wet during construction.
3. Allowing the timber to absorb moisture after the building is finished, because of leaks or lack of ventilation.
4. The use of timbers containing too much sapwood.
5. The use of timbers which have already started to decay.

The avoidance of these conditions will, as a rule, prevent decay. In special cases, however, decay can only be prevented by preservative treatment. For this purpose, salts such as zinc chloride and sodium fluoride are better than creosote for buildings.

Recent Pressure Tests of Welded Joints Indicate Their Value

By F. H. SIBLEY
Professor of Mechanical Engineering, University of Kansas

TESTS recently made in the machine-construction laboratory of the University of Kansas show that the joints made by the oxyacetylene method develop average strengths against rupture from internal pressure as great as, if not greater than, those which may be ordinarily expected from screwed pipe connections. The data

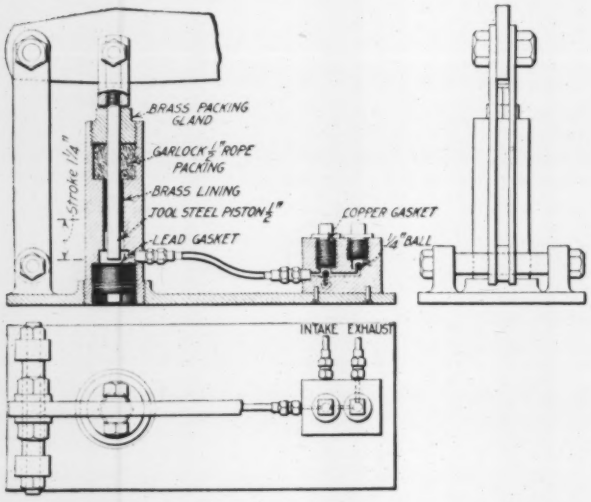
TESTS SHOW SUPERIORITY OF WELDED CONNECTIONS

Size Pipe	Type Joint	Pressure, Lb. per Sq.In. At Failure	Pressure, Lb. per Sq.In. Maximum	Nature of Failure
2 in.	Welded T	4,400	4,400	Tube seam split
	Welded T	2,200	2,200	Leak in tube seam
	Welded T	4,750	4,750	Tube seam split
	Screwed T	2,350	2,750	Sand holes in fitting
	Screwed T	500	2,000	Sand holes in fitting
3 in.	Butt weld		5,300	
	Butt weld	4,950	4,950	Tube seam split
	Butt weld		4,250	
	Coupling	3,950	3,950	Coupling split
	Coupling	3,400	4,400	Leak in coupling
	Welded T		3,500	
	Welded T		4,250	
	Welded T		3,505	
	Screwed T	350	2,700	Sand holes in fitting
	Screwed T	300	3,100	Sand holes in fitting
4 in.	Butt weld		5,100	Pipe bulged
	Butt weld		3,250	
	Coupling	300	3,000	Leak at threads
	Coupling	750	2,600	Leak at threads
	Welded T	3,850	5,100	Leak in weld
	Screwed T	1,000	1,950	Sand hole in fitting

given in the accompanying table are supplementary, but confirmatory of similar figures determined about a year ago.

The results indicate that the strength of a welded pipe connection is practically the same as that of unwelded pipe; and although careless welding might result in a leaky connection, if the line be tested when installed it should be immune from trouble in service.

A special high-pressure pump of simple detail was designed and built for this work. It was connected to the specimens under test by means of a ½-in. copper tube. A pressure gage, with a check valve opening toward



SPECIAL PUMP CARRIES PRESSURE OVER 5000 POUNDS

the gage, was located on the tube—the valve being necessary to steady the pressure in order that satisfactory readings could be obtained, because some of the samples carry pressures greater than 5000 lb. per sq.in. before failure.

Boiler Water Containing Sodium Hydroxide Makes Soft Steel Brittle

IN CERTAIN districts where feed water for boilers contains sodium hydroxide many boiler troubles have appeared which have given no little concern to boiler users and makers. Such water is found in the central eastern part of Illinois, in the Fox River Valley in the northern part of the same state and in portions of other states. The Engineering Experiment Station of the University of Illinois has just completed an investigation of this source of boiler distress, and the results are published in Bulletin 94 by S. W. Parr.

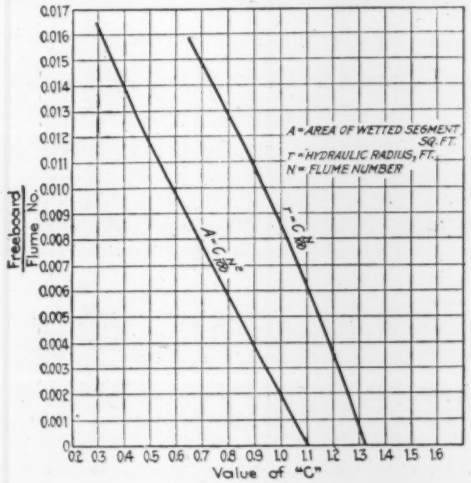
It was noted that boilers using feed water containing sodium hydroxide often developed fine cracks radiating from rivet holes or extending from hole to hole. The experiments showed that the effect upon the metal is to cause brittleness, which makes it less capable of withstanding steam pressure and temperature changes. Among the remedies suggested is the addition of a salt having properties that cause it to react with the alkali and yield a harmless product. Copies of Bulletin No. 94 may be obtained gratis by addressing C. R. Richards, Director, Urbana, Illinois.

Simple Curve Gives Hydraulic Elements of Semicircular Flume

By D. C. McCONAUGHY
Assistant Engineer, United States Reclamation Service, Denver

THE accompanying curves give the hydraulic elements of semicircular flumes, partly full, in simpler form than curves before published (for instance, in *Engineering News*, Dec. 14, 1916, p. 1142).

They can be platted in a few minutes from the elements of circular segments of radius unity, tabulated



CURVES FOR SEMICIRCULAR-FLUME COMPUTATIONS

in almost any book dealing with the flow in circular conduits, by using the commercial number of the flume, which is the length of the curved flume sheet in inches, instead of the diameter. The wetted perimeter, which is seldom used, can be easily found from the area, and the hydraulic radius or the curve can be drawn if desired.

Setting Street-Corner Radius Stake

By F. J. CROISSANT
State Department of Highways, Buffalo, N. Y.

IN SETTING radius stakes for street corners where the angle of the intersecting streets is not a right angle, the solutions shown in the following sketch save considerable time in finding the correct location for the radius stake.

Two methods may be used: (1) with transit at E, the intersection of the curb line and the center line of the

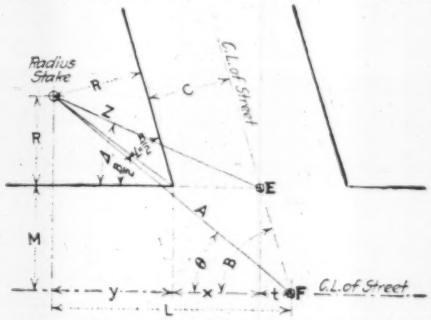


DIAGRAM FOR SETTING STREET-CORNER RADIUS STAKE

intersecting street; (2) with transit at F, the intersection of the center line of the two intersecting streets. Considerable time and instrument work are saved by using the method with F as instrument point.

For method 1, transit at E, the formulas are:

$$x = \frac{C}{\sin B} \qquad y = R \cot \tfrac{1}{2} B$$

$$\tan \measuredangle = \frac{R}{x + y} \qquad Z = \frac{R}{\sin \measuredangle}$$

For method 2, transit at F, the formulas are:

$$x = \frac{C}{\sin B} \qquad y = R \cot \tfrac{1}{2} B$$

$$t = \frac{M}{\tan B} \qquad L = x + y + t$$

$$\tan \theta = \frac{R + M}{L} \qquad A = \frac{R + M}{\sin \theta}$$

New York State Highway Engineers Utilize Lull in Construction

SCARCITY of labor, lack of supplies, reluctance of contractors to undertake work with the rising prices of materials and labor, the inefficiency of such labor as could be obtained and the caution of bonding companies in assuring new work were some of the obstacles to New York State's 1916 roadbuilding program. To combat them in the construction of 515 miles of road consumed enough energy to have produced double the product under normal conditions, according to the forthcoming annual report of H. Eltinge Breed, first deputy highway commissioner.

In spite of this drain on the energies of the Highway Department, the lull in construction was utilized by the staff to good advantage in making an engineering review of the plans of approximately 1000 miles of highway and in a study of the roads from a military viewpoint.

A Freight Bureau was also established; and communication was entered into with the railway companies, which resulted in many rate reductions on sand and stone. Tariffs to the number of 1100 were obtained from various railways. Files were provided, and the tariffs are being indexed. Another card index is started which gives the cost of sand and crushed stone from various sources to each point of destination in the state, thus making possible an accurate cost comparison of the available materials for any given locality. The reductions granted to the Freight Bureau by the railways show savings of from 10c. to $1.21 per net ton over the original tariffs.

The great advantage obtained from the work of the Freight Bureau is to show the cheapest possible material that can be used for any given project. The information thus gathered can in turn be made available to all departments and of course is valuable in making estimates and in furnishing more accurate bidding information to the contractor.

String Line Stakes on Wire To Prevent Mixing Numbers

By G. T. RITCHIE
Brits, Transvaal, South Africa

THE numbered line stakes carried by the South African axman shown in the photograph are strung on thin wire. Not only are they convenient to carry in this way, but, by threading them consecutively on the wires with the numbers in the inverse order in which they are to be driven, the selection of the correctly numbered stake is rendered foolproof.

SOUTH AFRICAN AXMAN CARRIES LINE STAKES STRUNG IN ORDER ON WIRE

NEWS OF THE WEEK

Current Events in the Civil Engineering and Contracting Fields

Cleveland May Buy and Operate Coal Mines

Proposal in Council Met by the United Opposition of Coal Operators

A crisis in the affairs of the Cleveland municipal lighting plant, brought about by soaring fuel prices, was revealed at a public meeting of the Council Committee on Light and Heat. A report from W. E. Davis, commissioner of light and heat, urging the purchase by the city of coal lands and the establishment of a municipal coal mine was placed before the committee. Coal operators are opposing the city's move, having asked Mayor Davis to prepare an estimate of the amount of coal needed by all city departments for the coming year, so that a joint bid may be submitted by them.

Resolution Introduced in Council

The following resolution was introduced: "Whereas, The experience of the Department of Public Utilities of the City of Cleveland during the last winter in the matter of securing coal presents questions of serious concern to the people of the City of Cleveland; Whereas, Many privately owned public utilities have already made purchases of coal fields in order to make certain the continuous operation of their plants at reasonable costs; now, therefore, be it Resolved, By the Council of the City of Cleveland, State of Ohio, that it is the purpose of Council to authorize by appropriate legislation the purchase of the necessary coal mines or coal fields to insure to the City of Cleveland a sufficient supply of coal to make certain the continuous operation of its light and water plants; and be it further Resolved, That the Council of the City of Cleveland hereby declares its intention to pass the appropriate legislation to authorize the necessary expenditures by the Department of Public Utilities for the employment of expert services needed in order that the city may determine the location and price to be paid by it for any coal mines or coal fields to be purchased."

At this date no definite action has been taken.

War Forces Suspension of "Excavating Engineer"

The "Excavating Engineer" has temporarily suspended publication, due to the fact that the editor, Bradlee van Brunt, and his assistant have been called to the colors. Mr. van Brunt, in making this announcement, hopes that when "our armies return victorious . . . those who have been with us in the past will not have forgotten the 'Excavating Engineer.'"

Engineers Will Hold Field Day

The annual field day of the New England Water-Works Association and the Boston Society of Civil Engineers will be held Wednesday, June 13, at Norumbega Park, Newton, Mass. A special car will leave Lake St., Boston, at 10:30 a.m. A baseball game has been scheduled between the two organizations, followed by a dinner at the park restaurant. Brief meetings of the societies will be held immediately after dinner.

Confer on Military Highways in Texas

The Department of Economic Geology of the University of Texas has sent its chief engineer, J. P. Nash, to San Antonio to confer with Col. W. C. Langfitt. Mr. Nash will lay before the army board a statement of the available military highways and railroads in the state and will furnish them with a statement of the amount and character of the highway material available in the state. A complete road map of the state compiled by the university, which clearly states the kind and condition of all roads included, has been prepared for the use of the army.

High-Level Bridge Project Below Albany Blocked

Despite the approval by the United States War Department of the plans presented by the New York Central R.R. for a high-level bridge across the Hudson River 10 miles south of Albany, N. Y., the construction of the bridge has been blocked by a new state law signed by Governor Whitman last week. The law repeals one passed in 1913 granting the company the right to build the bridge and substitutes permission to build one with a single span across the river.

The bridge in question is part of the proposed Hudson River Connecting R.R., planned to relieve bad operating conditions of the New York Central and the Boston & Albany in the vicinity of Albany. (See the "Engineering Record" of Feb. 24, p. 312.) The bridge as planned would provide a 600-ft. span over the present navigable channel and an auxiliary 405-ft. span just east of the main span, over shallow water that would be dredged to form a second channel. Opposition to the plan developed at Albany and vicinity, based on fears that the pier in what would become midchannel would be a menace to navigation. The War Department, in granting a permit for the bridge, declared these fears to be groundless, but the legislature, in attempting to overrule the War Department, has decided otherwise.

Industrial Adjustment Commission Proposed

Bill Before Congress Aims To Adjust Disputes Between Capital and Labor

A bill designed to prevent a tie-up of interstate transportation facilities through strikes and lockouts has been prepared by Secretary of Labor Wilson for introduction in the Senate. The measure also provides for the adjustment of labor disputes affecting the street-car systems of Washington.

The proposed law provides for the creation of a United States Industrial Adjustment Commission, to be composed of nine members, appointed by the President with the advice and consent of the Senate. Three of the members of the commission are to be representatives of wage earners engaged in interstate transportation; three are to be representatives of employers so engaged and three are to be representatives of the public.

Commission To Adjust Disputes

The purpose of the commission, as defined in the bill, is "the adjustment of controversies and disputes arising between employers of labor engaged in interstate transportation and wage earners employed in the same industry, concerning wages, or other terms or conditions of employment, and to execute the results of adjustment under the limitations of this act."

The commission is given jurisdiction in all cases in which controversies or disputes interrupt, or threaten to interrupt, interstate transportation; where the existence or pendency of such a controversy or dispute is presented in writing to the commission either by an employer or any person or persons representing 20% of any recognized division of labor; or when any strike or lockout has been, or is about to be, ordered.

Government To Buy Another Alaska Railroad

Secretary Lane announced June 1 that arrangements were being made for the purchase of the Tanana Valley R.R., a privately owned line in Alaska. This road runs from Fairbanks to Chatanika, with a branch to Chena, and traverses a country of agricultural and mineral wealth. This road will become a part of the Government railroad system now under construction in Alaska, the main line of which runs from Seward to Fairbanks, and will make available for mining operations in the Fairbanks district the coal in the Nenana field about 100 miles south of Fairbanks and adjacent to the main line.

Canadian Commission Buys Ontario Power Company

Becoming Largest Producer and Distributor of Electric Power in the World

Sir Adam Beck, chairman of the Ontario Hydro-Electric Power Commission, announces that the Commission has acquired the assets of the Ontario Power Co., of Niagara Falls, for $22,669,000 on the following terms—the company to deliver all its properties and contracts for power delivery for which the Commission agrees to pay $8,000,000 in its own debentures for the $10,000,000 of stock now held by the company and to assume the bond liability of $14,669,000 secured by a first mortgage on the property. The company is to receive the current assets and assume current liabilities. The Hydro-Electric Commission will take possession on Aug. 1. The Commission thus becomes a producer as well as a distributor of the electrical energy generated at Niagara Falls, and the largest establishment of its kind in the world. The company's book valuation is $26,900,694, and its total revenue for 1916 from the sale of power was $2,396,277—its net income being $1,501,353. Interest on its bonds was $767,118, leaving net earnings of $734,235.

To Divert 30,000 Second-Feet

The transaction is specially important as regards its bearing on the Chippawa Creek-Queenston Heights development scheme of the Commission, which contemplates the generation of 900,000 hp., on which $15,000,000 is being spent. This system may ultimately absorb that of the Ontario Power Co., by the diversion of the water to which the latter is entitled to the Queenston Heights power development plant. The Ontario Power plant has a franchise capacity of 180,000 hp. Under the treaty with the United States the Canadian companies are authorized to divert 30,000 cubic feet of water per second from the Niagara River, of which the Ontario Power Co. is entitled to 11,180 second-feet. It is claimed that the Hydro-Electric's new Chippawa plant will be 70% more efficient and economical than the existing plants owing to the greater head available. The Commission will have a 310-ft. head at the new Queenston Heights development plant, as compared with the 160-ft. head of the Ontario company's plant at Niagara Falls, which will enable it to develop 300,000 hp. as compared with the 180,000 hp. developed by the company. Construction work on the Chippawa-Queenston scheme was not started until the franchise of the Ontario Power Co. had been secured by the Commission, as it was regarded as essential to the success of the larger system. The Commission is now selling 150,000 hp. in the Niagara district alone which is expected to be increased to 200,000 hp. by November.

Stevens Arrives at Vladivostok

John F. Stevens, of New York, who heads the special commission of American railroad engineers sent to aid Russia in the solution of her transportation problem, has arrived at Vladivostok and has made arrangements to commence his work immediately. In the opinion of N. V. Nekrasoff, the Russian Minister of Communications, Mr. Stevens and the other American engineers can render an inestimable service. Realizing this, he has given them an absolutely free hand as to the needs of the Russian railways.

Navy Has Difficulty in Getting Aëronautic Draftsmen

It is announced that securing men capable of preparing notes and recommendations, checking plans and specifications, making sketches, designs and drawings in connection with sea planes and dirigibles is giving no little concern to the Navy Department. The need for qualified men is pressing and qualified men are urged to apply to the Civil Service Commission for Form No. 1312.

Competitors will not be required to report for examination at any place, but will be rated on the following subjects, which will have the relative weights indicated, on a scale of 100: (1) General education and technical training, 80.; (2) practical experience, 20.

Applicants for this position must be at least 20 years old and have the training and experience specified in one of the following groups: (a) Graduation from a high school or four full years of study in a school offering a course equivalent to that of a high school, and four years' practical experience as a draftsman, of which not less than six months was in connection with aëronautics; (b) two years of successful study in engineering in a school requiring high-school preparation for entrance and two years' practical drafting experience, of which not less than six months was in aëronautics; (c) two years' successful study in engineering in a school requiring high-school preparation for entrance, one year's experience as a mechanic or fixer in a machine shop and one year's practical experience in drafting, of which not less than six months was in connection with aëronautics; (d) a degree in engineering from a college or university of recognized standing or the fact that the applicant is a senior student in such a course in such an institution and expects to graduate within three months from the date of making oath to his application. Some colleges have expressed willingness to graduate senior students upon their being offered appointment by the Government.

Statements as to education, training and experience are accepted subject to verification. Applicants will be admitted to this examination regardless of their residence and domicile.

Connect Lowest Pair of New East River Tubes

Neither Tunnel Yet Continuous—Unusual Construction Avoids Extra Air Plant

Although the north tube of the south pair of new East River tunnels in New York City was holed through on June 2 by a blast fired by Clifford M. Holland, tunnel engineer of the Public Service Commission, so that it is now possible to walk from Manhattan to Brooklyn through these tubes, neither of them is yet continuous. The present passage is through the south tunnel on the Manhattan end, a connecting passage under Coenties Reef and the north tunnel on the Brooklyn end.

These tunnels are unique in that their east ends have been driven through hard rock in free air while the Brooklyn ends have been driven with compressed air and shields. Rock above the grade of the tunnel roof extends out to a reef about a third of the way across the East River. The east headings, to avoid erecting a compressor plant at the Manhattan end, were therefore stopped a hundred feet or more before running out of the rock, the plan being to drive the shield headings across the river and into the reef to meet them. The shield headings themselves had to pass through 600 ft. or so of a smaller reef near the center of the channel, being carried this distance under reduced pressure.

Encounters Treacherous Rock

This plan was carried out except that the north heading from Manhattan encountered a treacherous stretch where the rock cover became thin and gave signs of breaking in. Driving was stopped, while the south heading was successfully carried past this point and a drift over to the line of the north tube cut. From this drift the north tube was completed to the edge of the reef, and driven backward till the dangerous stretch of rock was encountered from the river side. Here it was decided to stop until a shield and air pressure from the Brooklyn side should be available to take out the remaining two stations with safety.

On this account the north Brooklyn heading, the shield for which would be the one available for driving this distance, was pushed ahead of the south heading. It is this north tube which was holed through on Saturday. Meanwhile the south rock heading had been pushed to the edge of the reef and a bulkhead with air locks built in it back of the cross passage to the north tube.

When the north shield neared the heading from Manhattan in the edge of the reef, a hole was drilled through, the lock doors in the Manhattan bulkhead closed, and the sections of rock tunnel beyond it "locked in" with the compressed air heading on the north tube. The remaining core of rock was then shot out under air pressure. The shield which arrived under the river from Brooklyn will be moved down the rock

tunnel by its own jacks and used to complete the north tube before the air pressure is taken off. Meanwhile, the south headings, which are about 200 ft. apart, will probably meet, so that air pressure will probably be taken off the whole work at once by the breaking through of the north shield into the shore rock heading of the north tube.

The maximum air pressure used in constructing these tubes has been about 37 lb. It is stated that check surveys showed the headings to have met ⅜ in. out of level and ⅞ in. out of line, the rock headings from the shaft out being about 1800 ft. long and the air headings double that length. The work on these tunnels is being done by the Flinn-O'Rourke Co., Inc., under the direction of the tunnel division of the Public Service Commission of which Robert Ridgway is chief engineer of subway construction.

Welland Canal Accident Second in Month

Steamer Enters Lock at Excessive Speed, Strikes and Carries Out Gates of Lock No. 1

The wooden steamer "Nipigon" struck and carried out the two headgates of Lock No. 1, Welland Canal, at about 4:45 p.m., May 26. The vessel and gates were carried out into the harbor below. Owing to the fact that the old and new canals are connected above Lock No. 1, a great quantity of water was released and it was not possible to close the two footgates until 4:15 a.m. on May 27, when the water had ceased to lower further. The large quantity of water coming down the old canal, which is used for water power, and from the tail race of the Cataract Power Co. made it very difficult to close the lower lock gates. When the gates were closed, which operation required but a minute or two, there was a head of approximately 6 ft. of water acting upon them.

Traffic Interrupted 26 Hours

Two spare lock gates were placed in position and the lock was ready for operation at 2 p.m. on May 27, but navigation could not resume as the reach had not sufficiently filled up. Traffic began again at 6:45 p.m., having been interrupted for 26 hours. About 17 downbound and 4 upbound vessels were delayed for periods varying from the full 26 hours to a few hours. The "Nipigon" was not seriously injured. Her propeller was badly damaged, two of the blades being broken off when the boat was carried by the rush of water into the west docking. The estimate of the cost of repairing the damage to canal property is $4000.

It appears that the cause of the accident was due to excessive speed of the vessel in entering the lock. The engines were not working ahead but centered. They could not be reversed in time to avert the collision with the upper gates. A wire cable placed on a snubbing post slipped through the compressor.

Strong Price Advance in All Lines

Wooden Shipbuilding and Army Requirements Reflected in Rise of $4 to $8 in Lumber Prices All Over Country—Shipbuilding Probable Factor in Further Steel Advance

Uncertainty as to Government requirements and as to labor supply appears to have been responsible in considerable measure for the remarkable advances shown on all sides in prices of engineering materials during the month of May. Although the 200,000,000 ft. of lumber which is said to be required for constructing sixteen army cantonments for the United States Government is far below 1 per cent. of the total cut of last year of the lumber mills of the country, it is reported that the prospect of the immediate placing of this order has demoralized the lumber market at more than one point. Even the three billion feet which is talked of for the wooden merchant fleet is a small part of our 40 billion foot annual output of lumber, yet prices have jumped over the entire country. In some places and in some lines, mills which can get lumber to market can demand any price they wish. It is believed, however, that even with the transportation situation at a most unfavorable stage and with the prospect of block buying of enormous quantities of timber by the Government, the present situation cannot be explained without assuming a good general demand and allowing for the long period during which stocks have been low and mills and yards have been deterred by general conditions from building them up.

Perhaps in a similar way the Government's requirements for steel have had some influence on the rapid rises in all lines of steel products used in engineering construction. While it has been estimated that the entire Government needs for steel, including a maximum program of building merchant vessels, will represent considerably less than 3,000,000 tons of the country's ingot capacity, which is more than twenty times this figure, the sudden necessity for covering these requirements and the probable rush on the part of other interests to make sure that their share is not cut down will account for the results manifest in the price list. The general and heavy advance in cement is doubtless explained in part by uncertainty as to the labor market on the part of the mills.

It may be that after the first rush is over some of the prices quoted this month will be found to have advanced too far. Certain it is that some of the gains, notably that in cement, will doubtless prove sufficient to shut off work on which the total funds available are limited, such as concrete highway construction. Up to the first of June, however, the value of construction contracts let compares favorably with the similar period of 1916, according to the figures of the F. W. Dodge Co. While the total of $456,000,000 estimated as the value of contracts awarded in the northeastern part of the country last year is far less than the $625,000,000 estimated for the past five months, much of this gain is undoubtedly accounted for by price advances during the last year. In spite of this, however, the entrance of this country into the war would appear to have had very little effect on the volume of building and engineering construction as yet in the territory mentioned, since most of the gain shown by this year over 1916 has occurred in the past two months. It is evident that industrial building is extremely active in certain lines, and from Canada's experience we may expect it to continue so during the war.

The country is now finding its bearings; and it is not apparent that contractors, more than any other business men, have any reason to expect ruinous conditions.

Terminal Engineers Hold Their First Meeting

At a meeting of the Society of Terminal Engineers, Tuesday night, May 29, in the Engineering Societies Building, West 39th St., New York City, a committee was appointed to devise means to relieve freight congestion. The committee consists of Francis Lee Stuart, of New York; E. H. Lee, of Chicago, and George H. Kimball, of Detroit. A special effort will be made to find mechanical means to lessen the need for manual labor at freight terminals. It was reported that a number of Western roads were planning to ask the state authorities to supply convict labor.

The president of the Society of Terminal Engineers is H. McL. Harding, of New York. Its vice presidents are Gen. W. H. Bixby, Corps of Engineers, U. S. A.; John Meigs, of Philadelphia, and B. F. Cresson, Jr., of New York. The secretary is J. H. Leonard, of New York.

Open New York Subway Spur

The first section of the new Seventh Avenue, New York, subway was opened June 3. Connecting Times Square, at 42nd St., with the Pennsylvania Station, it affords shuttle service between this station and the Interborough subway system and furnishes rapid-transit connection between the two great railway terminals of the metropolis.

The engineers who made the first trip were surprised at the smoothness of the roadbed, declaring it a great improvement over the design used in the existing subways. A raised foot path built alongside the tracks is a detail which will be of great service in case of an accident, since passengers using it would not be exposed to the danger of the third rail.

Spring Floods Damage New Bridge at Spokane

FALSEWORK SAVED BY BUILDING STONE AND CABLES

The highest water in the Spokane River, Washington, since 1894 was experienced during the week of May 13 to 19. Several bridges were under construction at the time, and much effort had to be exerted to save some of them. The Natatorium Park bridge, which carried the water mains to Fort George Wright, went out, causing much damage. However, a new bridge was to be built soon. A large cofferdam of the Olive Ave. concrete bridge now under construction was washed out on May 16, when the flow reached 39,500 sec.-ft. At the Division St. concrete bridge, which is under construction, a part of the falsework was washed out, and the structure was weighted down with stone to prevent further damage. Heavy ropes and wire cables were also used to anchor the falsework. Part of the concrete had been poured before the high water arrived. The water reached a flow of 41,600 sec.-ft. at this bridge.

St. Paul Civil Engineers Propose City-Planning Commission

A city-planning commission, made up of technical men, was recommended for St. Paul in a report by the Civil Engineers' Society, filed recently with the mayor. The report favored the appointment of a board of St. Paul men to "cooperate and develop the growth of the city" and goes on to say:

"The Civil Engineers' Society feels that St. Paul should not be allowed to grow unplanned until improvements that we require are forced on us at enormous expense. . . . Further, the society believes that the city should have a commission of technical men who could study and watch the growth of St. Paul and plan for its future and present growth in a manner that may lead to the most efficient and thorough results in building up the city in an economical manner.

"The bringing in of outside men to draw a so-called city plan has never amounted to a great deal more than propaganda. The City of Minneapolis had extensive plans drawn some years ago, but as yet no great results have been obtained.

"The society believes . . . that a group of men could be formed who would coöperate and develop the growth of the city in the most efficient and systematized manner. Further, that this group should be obtained from our own professional men. . . ."

To Begin Again on West Side Improvement

New Law Puts New York's Big Railroad Project Under Utility Commission

Exclusive jurisdiction over New York City's so-called West Side improvement is taken from the city's Board of Estimate by a new law signed by Governor Whitman last week. The new law gives the (State) Public Service Commission for the First District joint authority in the proceedings, and provides further that if the commission and the Board of Estimate do not come to an agreement by Dec. 1 the board will lose entire jurisdiction over the matter. Another bill, the Green bill, was also signed, providing for an investigation by a committee of seven of the whole matter and the work done to date.

Removes Track from "Death Avenue"

The West Side project contemplates the complete reconstruction of the freight line of the New York Central R.R. in New York City, from Spuyten Duyvil to St. Johns Park. It involves additional trackage, four new terminals, removal of the tracks from "Death Avenue," the covering of the tracks along Riverside and other parks, and various other improvements. The cost of the work has been estimated at upward of $50,000,000, of which the company would pay all, except some $6,000,000 excess value of land ceded by the city to the railroad over that surrendered by the railroad. Included in the present plan is about $15,000,000 worth of park work which the company would do from which it would derive no direct benefit.

The present plan, which was made public early last year, is the result of five years' study and negotiation by the Board of Estimate and the railroad's representatives. Legislative authority to handle the problem for the city was given the Board of Estimate by an act passed in 1911. It is generally understood that the Public Service Commission will not accept the proposed contract without sweeping changes, and it is believed by many that the two new laws will delay construction work for years.

Tennessee Holds Examination for Highway Engineers

An examination for highway engineers was held in the House of Representatives at the Tennessee State Capitol, Tuesday, May 29, by the board of examiners of the Tennessee Highway Commission. Under the state act providing for state and national coöperation only engineers who have passed an examination are eligible for employment on state and national road construction.

As mentioned in these columns, May 24, this examination was held by a special board of the Tennessee Highway Commission, consisting of Prof. C. E.

Ferris, of the University of Tennessee; Dr. A. H. Purdue, state geologist, and A. M. Nelson, chief engineer, all members of the highway commission.

Several States Represented

Between 30 and 40 highway engineers took the examination. In addition to Tennessee and other Southern states, New York and Ohio were represented. W. P. Butler and R. C. Fergus, division engineers of the State Highway Commission, were in charge of the examination.

The following is a list of the engineers who stood the written examination May 29: S. M. McMurray, Smyrna, Tenn.; A. C. Hamilton, Jr., Winchester, Tenn.; Walter H. Drain, Lebanon, Tenn.; E. N. Todd, Fort Morgan, Ala.; John P. Brown, Madisonville, Tenn.; C. E. Coile, Greenville, Tenn.; C. W. Cooper, Anniston, Ala.; Oliver La Pointo, Nashville, Tenn.; S. E. Neil, Hamilton, Ala.; Eberle D. Trickey, Wilmington, Ohio; O. F. Goetz, Knoxville, Tenn.; N. E. Rice, Chicago, Ill.; Frank W. Webster, Louisville, Ky.; James H. Stone, Wickliffe, Ky.; J. E. Mooreland, South Pittsburg, Tenn.; R. M. Barller, Lawrenceburg, Tenn.; C. E. Shearer, Memphis, Tenn.; S. G. Walker, Memphis, Tenn.; R. K. Williams, Elizabeth, Tenn.; E. Jack Smith, Rockwood, Tenn.; W. I. Smith, Ooltewah, Tenn.; A. R. Coons, Aurora, Ill.; George Yavroumis, Binghamton, N. Y.; W. G. Daniel, Chattanooga, Tenn.; J. Sekemeyer, Nolensville, Tenn.; L. B. Bryan, Chattanooga, Tenn.; E. G. Murrell, St. Elmo, Tenn.; Knapp Milburn, Chattanooga, Tenn.; N. W. Dougherty, Knoxville, Tenn.; Edgar H. Baker, Cincinnati, Ohio; R. J. Love, Madisonville, Tenn.; D. W. Harmon, Maryville, Tenn.; W. P. Moore, Columbia, Tenn.

Engineering Societies

The Oakland Engineers' Club, recently organized at Oakland, Calif., to affiliate the engineering members of the Chamber of Commerce of that city, has for its purpose the discussion of the engineering problems affecting the east bay cities. At a smoker on May 16, a large attendance listened to the following addresses: "Aims and Objects of the Club," by Harlan D. Miller; "East Bay Water Plants," G. H. Wilhelm, chief engineer and manager, East Bay Water Co.; "Municipal Problems," R. S. Chew; "Military Preparedness," Thomas J. Allen, chief engineer, Realty Syndicate; "Electric Test Laboratories of New York," H. H. Millar; "Manufacturing Sanitary Bottles from Wood Pulp," William H. Fulcher. The officers of the new association are Harlan D. Millar, president; John Britton, Jr., secretary.

The Engineers' Club of Trenton, N. J., gave a smoker Friday evening, June 1, in its clubrooms. This was the last meeting of the club until October. An educational motion picture, "The King of the Rails," depicting the evolution of transportation, was shown.

The American Institute of Electrical Engineers has cancelled its annual convention, which was to have been held at Hot Springs, Va., having received information from various sources that many members would not be able to attend, due to the national situation. Many who are particularly active in the affairs of the institute, have already received commissions in the Engineer Officers' Reserve Corps, and a large number are, or soon will be, rendering service to the Government.

The Society of Automotive Engineers will hold its summer meeting, June 25 and 26, at the Bureau of Standards, Washington, D. C. The professional session will be held Tuesday, the papers being of a practical nature. Newton D. Baker, Secretary of War, will address the meeting. From present indications, over 800 members will be in attendance.

The American Society for Testing Materials will hold its twentieth annual meeting, June 26 to 29, at the Hotel Traymore, Atlantic City. Besides the reports of 30 technical committees, 31 papers covering a wide range of testing, inspection and the peculiar field to which the society is dedicated will be given. From present indications the attendance will not suffer from war conditions.

The American and Canadian Engineers and Architects of Norwegian Birth or Descent will hold an informal congress and reunion at the Chicago Norske Klub, Chicago, Sept. 27 to 29. The program, covering three days, will include an inspection of the Chicago freight subway, the drainage canal and many other points of interest to engineers and architects.

The Engineers' Club of Philadelphia, at its thirty-eighth annual meeting, held May 15, elected the following officers: President, J. A. Vogleson; vice president, William C. L. Eglin; treasurer, Jonathan Jones; directors at large, R. H. Fernald and George R. Henderson.

Personal Notes

C. D. Young, who since 1911 has been engineer of tests of the Pennsylvania Lines East, has been promoted to superintendent of motive power of the Philadelphia, Baltimore & Washington. Mr. Young has been chairman of Committee A1 (on steel) of the American Society for Testing Materials for several years.

H. E. Osburn has recently been made resident engineer of the Kerr Trading and Oil Co., with headquarters at Maricopa, California.

Walter S. Standifer, who served as sanitary engineer at Panama under Gen. William C. Gorgas, and who was an agent of the American Red Cross in stamping out typhus fever in Servia, has been engaged by large North Carolina lumber interests to take charge of the sanitary engineering necessities of their large labor force.

J. L. Eagle, bridge and building supervisor of the Chattanooga division of the Nashville, Chattanooga & St. Louis Ry., at Tallahoma, Tenn., has been appointed division engineer, with office at Nashville, to succeed **R. M. Milam**, who is now serving in the National Guard.

George A. Reed has resigned as city engineer of Montpelier, Vt., to accept the office of assistant state engineer of Vermont.

J. O. Borreson has been appointed assistant to the state highway engineer of Utah.

Louis R. Ash, consulting engineer, of Kansas City, has been selected to be city manager under a new form of municipal government by the city commissioners of Wichita, Kansas.

Vaughan Wood, formerly assistant engineer of the Waterford Irrigation District, California, is now with the Stanislaus (Calif.) County Highway Association.

Galen B. Owen has been appointed superintendent of maintenance of the Erie R.R., with offices in New York City.

E. L. Markham has been appointed engineer of the northern division of the St. Louis Southwestern Lines, with headquarters at Pine Bluff, Arkansas.

E. B. Rannells, formerly assistant engineer in the electrical department of the New York Central Lines, New York City, has resigned to become assistant electrical engineer with Henry L. Doherty & Co. He will be stationed in Toledo, where a 160,000-kw. power station is being built for the Acme Power Company.

W. H. Leonard, president of the Denver Rock Drill Manufacturing Co., Denver, has organized and been elected captain of Troop E, First Regiment of Colorado Cavalry.

O. H. Taylor, who has been mainly engaged in railroad work since 1911, is now superintendent for the Parker-Washington Co. at Kansas City, Missouri.

J. B. Ennis, formerly chief mechanical engineer of the American Locomotive Co., has been promoted to vice presidency and will have charge of engineering.

I. A. Baum, formerly city engineer of Texarkana, Ark., and consulting engineer for the Martin Free Bridge at Camden, Ark., has been appointed assistant manager of the La Salle Engineering Co., Chicago.

C. A. Truitt, formerly assistant engineer of Bozeman, Mont., is now supervising engineer on sewer construction for Burns & McDonnell, consulting engineers, Kansas City, Missouri.

Louis **W. Hall**, for some years an assistant engineer in the United States War Department, and for the last two years with the Alabama Power Co., is now connected with the hydraulic engineering department of the Aluminum Company of America, Pittsburgh.

E. R. **Gray**, formerly deputy city engineer of Hamilton, Ont., has been appointed city engineer and manager of the water-works and sewage-disposal works.

J. B. **Dickson** has been appointed general superintendent of transportation of the Delaware & Hudson R.R., with offices at Albany, N. Y. Mr. Dickson succeeds C. E. Burr, resigned.

Benjamin F. Bush, whose election to the presidency of the reorganized Missouri Pacific R.R. was announced in these columns last week, was born in Wellsboro, Penn., in 1860. Beginning his railroad service as a rodman on the Northern Pacific Ry. in 1882, he was made division engineer on the Union

Elected President of Reorganized Missouri Pacific R.R.

Strauss Photo

BENJAMIN F. BUSH

Pacific R.R. five years later. In 1889 he went to Seattle, Wash., and for seven years was chief engineer and general superintendent of the Oregon Improvement Co.; later he was general manager of the Northwestern Improvement Co., at Roslyn, Wash. His first service with the Gould lines began 10 years ago as fuel agent of the Missouri Pacific Ry., at St. Louis, Mo. In 1907 he was made president of the Western Maryland Ry., was later receiver, and after the reorganization of the company was re-elected president. He was elected president of the Missouri Pacific Ry. in 1911 and president of the Denver & Rio Grande in 1912. Mr. Bush was a consulting engineer of the United States Geological Survey in 1900, and was appointed by President Roosevelt a member of the advisory board on fuels and structural materials in 1907.

F. Ringer, who has been connected with the Missouri, Kansas & Texas Ry. since 1894, was promoted from the position of engineer, maintenance-of-way, to that of chief engineer, with headquarters in Dallas, Texas.

Daniel T. Pierce, of the staff of the Barber Asphalt Paving Co., has been appointed executive director of the Committee of Public Safety for the Commonwealth of Pennsylvania.

Earle R. Seaman, who for the past year has been in charge of construction work for the Pennsylvania R.R., is now with the Turner Concrete Steel Co., supervising the erection of a factory at Red Bank, New Jersey.

J. H. Reinholdt has been appointed chief engineer of the Minneapolis & St. Louis R.R., with headquarters in Minneapolis.

Frank Y. Low and **N. P. Zech**, who have been associated for many years with H. M. Byllesby & Co., have become associated with the General Engineering and Management Corporation, New York. Mr. Low has been elected president and director, and Mr. Zech, vice president.

Earl F. Dickinson, for the past three years deputy engineer of Mason County, Washington, has accepted a similar position with Pacific County, Washington.

F. L. Bock recently resigned from the position of assistant engineer, Distribution System, St. Louis Water Department, to survey, for the Missouri Inspection Bureau, the water, electric and fire equipment of the cities of Missouri.

Paul Sterling has been appointed to the newly created position of engineer, lines west, of the New York, New Haven & Hartford R.R. With the exception of the years 1902-04, Mr. Sterling has been with the New Haven road. **W. D. Warren** has been named to fill a similar position for the lines east.

J. E. Bernhardt has been appointed bridge engineer of the Chicago & Eastern Illinois R.R., with office at Chicago.

C. A. Hays has been appointed general manager of the Canadian Government railways east of the St. Lawrence River, including the Intercolonial and Prince Edward Island railways; and **F. B. Brady** to a similar position for the railways west of the St. Lawrence, with headquarters at Cochrane.

H. B. Grant has been named city engineer of Deer Lodge, Montana.

D. M. Faries has been named city engineer of Wallace, Idaho.

Clifton J. Hobbs, who was engaged in engineering work with the Chicago & Wabash Valley Ry., has been made drainage commissioner of Jasper County, Indiana, and is superintendent of construction of the improvements of the Kankakee River, with office at Rensselaer, Indiana.

Wallace Treichler has been renamed city engineer of Rock Island, Ill., for a term of two years.

William H. Connell, whose resignation from the office of chief of the Philadelphia Bureau of Highways was noted in the issue of May 24, was born in New York City, 1878. After an extensive surveying experience in and around

Resigns from Philadelphia Bureau of Highways

WILLIAM H. CONNELL

New York, he was in charge of the field work and second in charge of the office work on the Madison Ave. concrete bridge, and in 1910 was appointed deputy Commissioner of Public Works, Borough of the Bronx. The reorganization of the Bureau of Highways of the Philadelphia Department of Public Works was undertaken by Mr. Connell in 1912. He revised the specifications and reorganized the work of the street-cleaning division immediately and placed the direction of the work in the hands of the district engineers, in this way combining construction and maintenance. An extensive publicity campaign was started by Mr. Connell about a year ago, having in view the enforcement of the ordinances regarding the type of rubbish receptacle and the separation of wastes. These and other plans were beginning to bear fruit when the ordinance depriving him of power over the street-cleaning forces was introduced in the Council. As announced in the previous issue, Mr. Connell is now connected with the firm of Day & Zimmerman as chief executive and general manager.

Clifford E. Hickok has been appointed city engineer of Alameda, Calif., resigning from the work of the Interstate Commerce Commission.

F. P. Gutelius, general manager of the Canadian Government railways, has been offered the position of vice president of the Delaware & Hudson Railway.

W. W. Kelly has been appointed division engineer on the Albuquerque division, Atchison, Topeka & Santa Fe, succeeding **M. C. Bryan**.

John H. Mullen, who served as deputy road engineer under the old Minnesota State Road Commission, has been appointed deputy by Charles M. Babcock, state highway commissioner.

H. E. Astley, who has been appointed superintendent of the Midland division of the New York, New Haven & Hartford Railroad Co., started his railroad work with the Pennsylvania R.R. in 1892. Since 1894 he has been connected with the New Haven road in the positions of roadmaster, supervisor and trainmaster.

W. C. Baisinger, formerly engineer of the Missouri division of the Atchison, Topeka & Santa Fe Ry., has been transferred to the Chicago headquarters as assistant engineer of construction.

R. K. West, formerly assistant division engineer with the California Highway Commission, has been appointed chief highway engineer of Nevada. Mr. West opened headquarters at Carson City, Nev., on June 1.

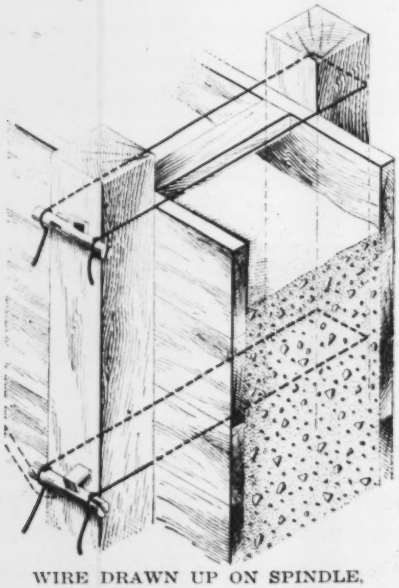
A. A. Matthews, engineer maintenance-of-way of the Missouri, Kansas & Texas, lines south, at Dallas, Tex., has been appointed engineer maintenance-of-way, lines north, with headquarters at Parsons, Kansas.

W. F. Pollard, formerly student assistant in the Department of Tests and Research in the United States Office of Public Roads and Rural Engineering, has been appointed inspector of roads for the State of Kentucky, with headquarters at Louisville, Kentucky.

Appliances and Materials

Pinch Bar Operates Form Clamp

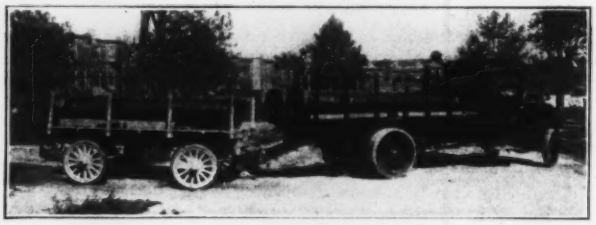
A new form clamp consists of a spindle with slotted ends around which the wires are coiled as the clamp is tightened by means of a pinch bar or curved tool inserted in one of two slots through the center of the spindle. Locking is effected by an angular key with one leg of the angle longer than the other inserted into one of the central slots, the projecting arm engaging the post. This makes it possible to lock the spindle in 16 different positions. The clamps are patented and are being marketed by F. G. Millan & Son, contractors, Minneapolis.



WIRE DRAWN UP ON SPINDLE, WHICH IS KEY-LOCKED

Rubber-Tired Trailer of 2½-Ton Capacity

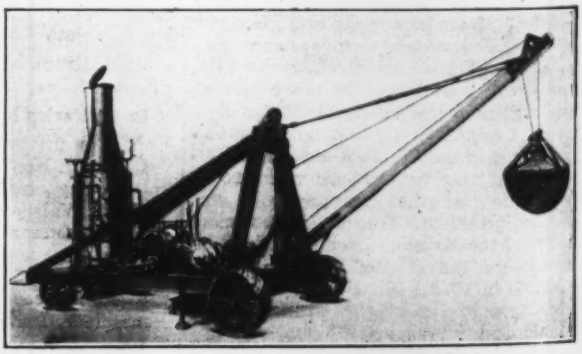
The Troy Wagon Works Co., Troy, Ohio, has recently sold the District of Columbia water department a 2½-ton trailer, equipped with 4-in. rubber tires. This trailer is provided with a stake platform body, and is used mainly for the hauling of water pipes from yard to works. The motor truck shown in the illustration is an Alco.



RUBBER TIRES ON STAKE-BODY TRAILER

Traveling Transfer Machine Boom Has Many Uses

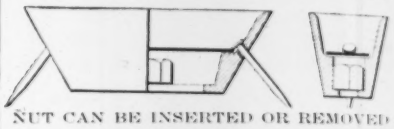
For the transfer of material from stockpiles or bins to cars or trucks, backfilling, piledriving, handling lumber or structural material, the Clyde Iron Works has brought out a traveling transfer machine. It consists of a mounted double-drum 20-hp. hoisting outfit equipped with an 8 x 8-in. timber mast, 20-ft. boom and a ½-yard clamshell bucket. It may be propelled through the front-wheel drive at 2½ miles per hour. The engine has a load capacity of 4500 lb. and is fitted with a swinging gear in front of the engine. Stability is effected by outriggers extending from the top of the rectangular frame and ending in a bearing shoe. The outfit weighs 11 tons.



LIGHT TRANSFER MACHINE CAN BE USED AS BACKFILLER

Improves Concrete Insert

A slight change in detail in the concrete insert manufactured by the Wright & Alexander Co., Rochester, N. Y., has made it possible to place or remove the nut within the adjustment chamber after the concrete has hardened and the forms are removed. A reference to the accompanying sketch will show that provision is made that the insert may be attached to the form planking by two nails in such a manner that very little difficulty is presented in removing the forms. A strip of tin, held in place by the nail heads, keeps the concrete from flowing into the space reserved for the nut.



NUT CAN BE INSERTED OR REMOVED

New Diaphragm Force Pump

A new design of diaphragm force pump has been made by the Goulds Manufacturing Co., of Seneca Falls, N. Y., to supply the demand for a moderate-priced compact pump good for a force head of 15 ft. plus ordinary diaphragm-pump suction lift. The discharge end has an air chamber, and the discharge elbow opening from this can be turned in any one of four directions. Both suction and discharge connections are cut for 3-in. hose or pipe thread. The diaphragm is 12 in. in diameter and the valves are of rubber-faced metal. A lever is provided for hand operation, and the socket is double, so that two levers may be used. For use with portable power, the pump is mounted on a frame, together with a pulley and gear jack working the lever. The stroke is 3 in. and the capacity 7500 gal. per stroke, or 2400 gal. per hour. The pump alone weighs 198 lb. and sells for $30.